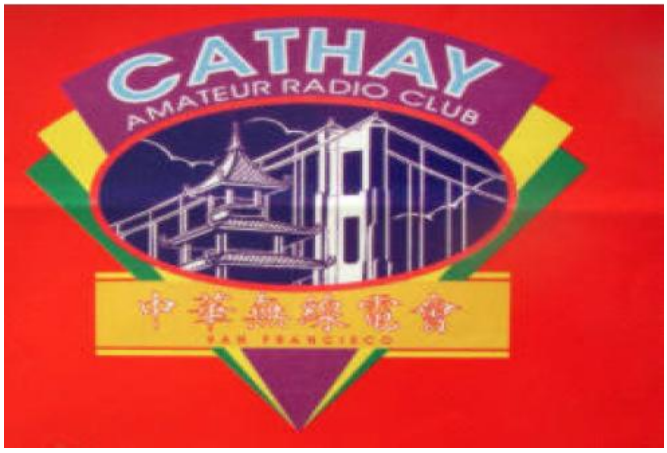


Cathay March 2013

www.cathayradio.org

President: George Chong, W6BUR **email:** *W6BUR@comcast.net*

Vice President North: Leonard Tom, *NX6E* **email:** nx6e@hotmail.com

Vice President South: Bill Fong, *W6BBA* - **email:** w6bba@arrl.net

Secretary/Membership: Bill Chin, *KC6POF* - **email:** bill.kc6pof@comcast.net

Editor: Rodney Yee, *KJ6DZI* - **email:** rodyee2000@yahoo.com

Treasurer: Vince Chinn aka Mingie, *W6EE* - **email:** vince@vincechinncpa.com

Web Master: Edison Fong – *WB6IQN* - **email:** edison_fong@hotmail.com

Mission: The Cathay Amateur Radio Club is basically an active social club of Ham Radio Operators and their spouses. We support local community requests for HAM emergency communications. Several of us are trained in CPR/ First Aid and are involved with community disaster preparedness.

Monday Night Net Time: 9 PM Local Time/PST, Frequencies: 146.67MHz -600KHz PL85.4 and 442.70 +5MHz PL 173.8. The repeaters are linked only during the CARC Monday night net. The CARC Monday night net is the best way to find out the latest club news. All check-ins are welcome.

Message from the President: George Chong, *W6BUR*

Hello CARC Members and Friends;

Our Cathay club celebrated the Chinese New Year of the Snake with a heck of a terrific turnout of 54 members and their guests.

We had a wonderful large group of people from afar and that we have not seen in a while. CARC South Vice President - W6BBA came in all the way from Santa Ana in Southern California to celebrate with us. Several club members that we have not seen in person for quite a while showed at our luncheon. **Now how about that for dedication from our fellow CARC members to attend our luncheon, it does not** get any better than that. For those CARC members who missed our fabulous luncheon, we hope you will try harder to clear your schedule for next year, we would certain enjoy your company.

My special thanks go out to the following people that took time out from their busy schedule to make this one of the best luncheon yet:

- Hetty – WB6SHU distributing out the CARC name tags.
- Mingie – W6EE for collecting and handling the money.
- Shirley – KF6DD for assisting with the collection of the money.
- Bill – KC6POF for taking pictures and handling the luncheon pre-registration.
- Ron – KI6AZB for donating a copy of his newly published book & taking pictures.
- Bill – W6BBA for taking pictures and traveling up from LA.
- Edison - WB6IQN for obtaining the fabulous raffle prizes and handling the raffle.
- Dale - K9ZPY for his generous donation toward the raffle of the two BaoFeng radios.
- All the CARC members and guests who attendance made this luncheon memorable.

I am sure I accidently left off some folks that had to travel some distance so please forgive my forgetfulness.

Special thanks to Bill - KC6POF for his untiring logistics of a more than competence CARC secretary, Rodney – KJ6DZI our CARC Editor for preparing the luncheon name tags and of course to Mingie - W6EE, our treasurer for his beautiful handwritten signature on all the club's checks. Other special thanks to our terrific Monday night net control folks who keeps our club active and together! These are the people that make the CARC president look good. Without the fore-mention people one can only wonder where would the club be? And without dues yet! I could never be this lucky again.

Report on the 2013 Annual Chinese New Luncheon:

In this newsletter is there is a special section on pictures taken at the luncheon event. I thank the following photographers for their pictures:

- Bill - KC6POF
- Bill - W6BBA via John - W6QNT
- Edison - WB6IQN
- Ron - KI6AZB
- Rodney – KJ6DZI

Edison – WB6IQN out did himself by pulling off another hugely successful and memorable raffle of several terrific prizes.

The CARC luncheon raffle prize winners were:

- Edison (WB6IQN) – Yaseu FT897D with the ultra-stable oscillator.
- Dan (K6GOW) – BaoFeng UV-3R in Red
- Bob (W6VVQ) – BaoFeng UV-3R in Black
- Nelson (AD6XZ) – Ronald Quan's book: Build Your Own Transistor Radios.

Please note that Edison's winning grand prize raffle ticket was drawn by 12 year old Ryan - KJ6WGS, our youngest HAM licensed club member.

Special Message of Thanks from Our Grand Prize Winner: Edison - WB6IQN

Edison has written a special thanking the CARC membership.

Public Service Announcements:

Edison –WB6IQN will be making a presentation on antennas at the April 2013 ORCA meeting.

SFPD ALERT training, I wish to call your attention to the San Francisco Police Department offering their very first ALERT training program on April 13, 2013.

Further details are contained in the Public Service Announcement section in this newsletter.

Featured Tech Article:

Check out the innovative application of thin film solar cells (TFSC).

Ed –WB6IQN pointed out that these thin film solar cells only have an efficiency rating of around 10+%. For additional information on TFSC check out the link:

- http://en.wikipedia.org/wiki/Thin_film_solar_cell

CARC Final Wrap News:

Chat sub s'em to all you CARC members!

- George W6BUR.

Report on the 2013 Annual Chinese New Luncheon

The 2013 Annual Chinese New Luncheon was held on Saturday, February 22, 2013. We had 55 club members and guest attend the luncheon held at KOME Restaurant in Daly City.

The following pictures taken at the lunch tell the story better than words alone:

Luncheon guest were greeted at the door by Hetty, George, Mingie, and Shirley.

Mingie - W6EE and Shirley - KF6DD, XYL of Mingie

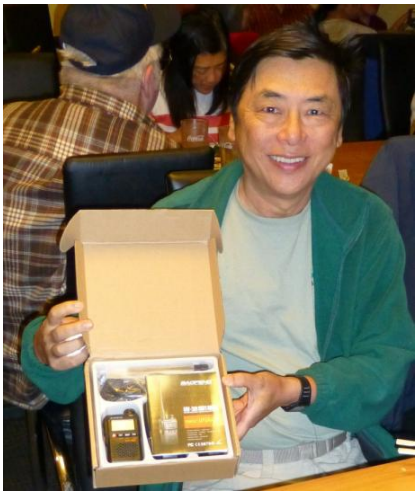
Hetty - WB6SHU

Bill - KC6POF, CARC Secretary

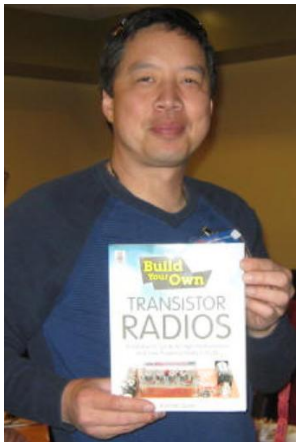
Hetty – WB6SHU, Ryan- KJ6WGS, George W6BUR

Edison WB6IQN holding his winning raffle grand prize: Yaseu FT897D

Dan - K6GOW holding his winning raffle prize: BaoFeng UV-3R



Bob – W6VVQ holding his winning raffle prize: BaoFeng UV-3R



Nelson – AD6XZ holding his winning raffle prize

Edison – WB6IQN Celebrating his win of the grand raffle prize

Gary – KN6LV, Chris - KE6FOX, and Maria - W6SIJ

Flo (XYL of Bill - KC6POF) & Howard - N6MNV

Linda and Gordon – KG6FAN

Connie, sister of Harry - KJ6DYY

Harry – KJ6DYY and David – NC6D

Paul – W6NDA and John - W6QNT

Ron - KI6AZB and Leonard - NX6E

Foreground: Jiaming and Phoebe of CIS Club.
Background: Bill - KJ6WGX of American Red Cross and
Lavinda - KJ6WGV of NERT

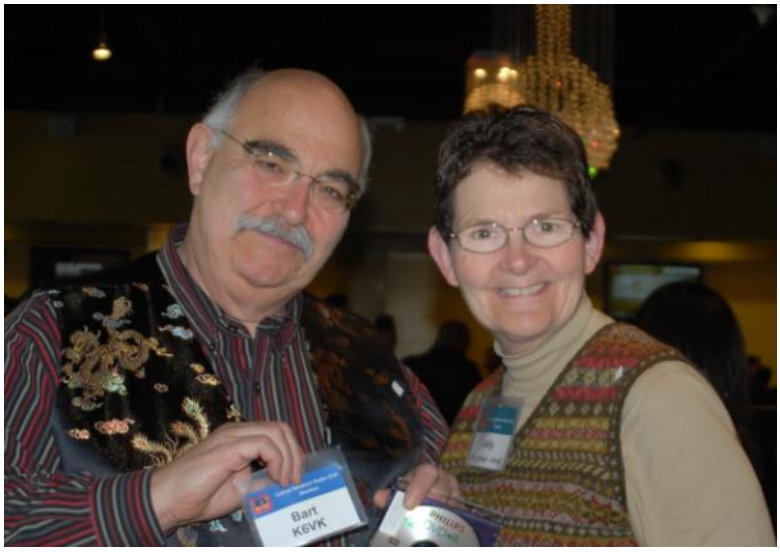
Leang -K6LJF

Kate (XYL of George) and George - NT6G

From left to right: Nelson - AD6XZ,
Dan - K6GOW, and Bob - KM6QP

Alon – WA6GTY

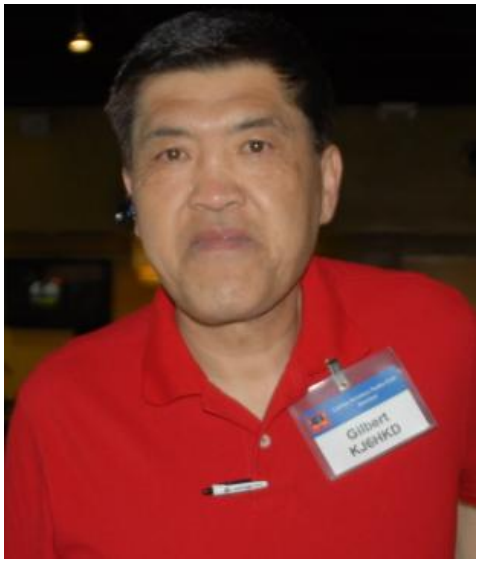
Grant - KJ6WGT, guest of Mingie W6EE



Bart – K6VK and Judy (XYL of Bart)

Rose (XYL of Dirk) and Dirk - KE6ZUY

Linda (XYL of Bill) and Bill – KN6QD

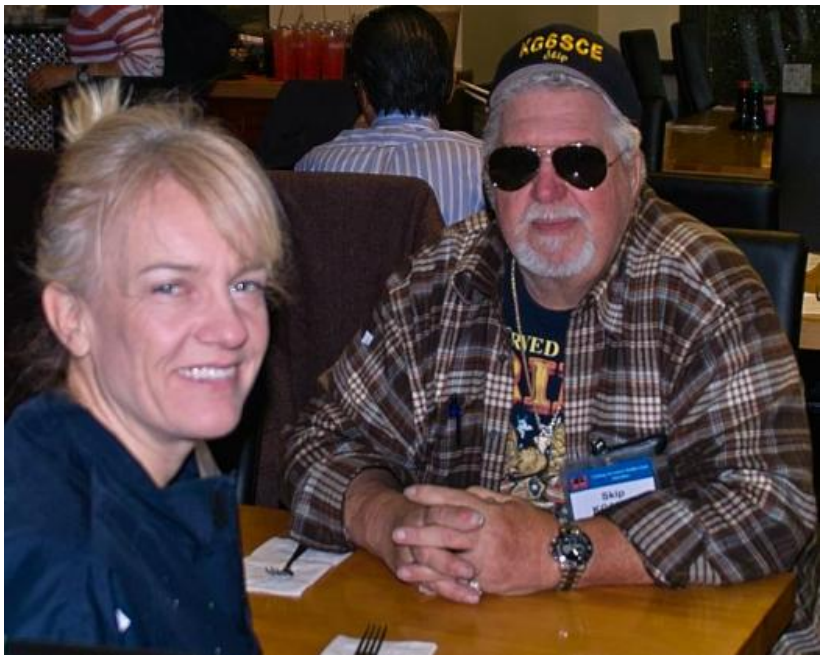


Gilbert - KJ6HKD

Dave - WZ6X and Nelson - AD6XZ

Kate (XYL of George – NT6G)

Grant - KJ6WGT, Gilbert - KJ6HKD, and George - W6BUR



Kira (guest of Skip) and Skip – KG6SCE

Allen - KI6YRL and son, Aidan

Judy (XYL of David–NC6D) and Linda (XYL of Gordon–KG6FAN)

Ryan – KJ6WGS

Bob - KM6QP and Bill - W6BBA

Mrs.Halog, Mother of Tony- KR6EG

Tony - KR6EG and Connie - KF6WEA

Grant - KJ6WGT

Peter - KE6GG (guest of Ed - WB6IQN)

Judy and Bart - K6VK. Bart is a well-known writer of HAM articles who has contributed to both the CARC newsletter and to the California Historical Radio Society.

CARC Club during luncheon. Of note in the picture are three lovely ladies smiling for the picture: Kate, Judy and Linda.

Clockwise starting from the left: Mingie – W6EE, Shirley - KF6WDD, Linda and Gordon - KG6FAN

On far right is: Hetty - WB6SHU.

On foreground left to right is: Mingie - W6EE and Shirley - KF6WDD

On background left to right is: Rodney - KJ6DZI and George - W6BUR

Chris - KE6FOX and Gary - KN6LV

Mingie - W6EE and Shirley - KF6DD, XYL of Mingie

Aidan, son of Allen - KI6YRL

Special Message of Thanks from Our Grand Prize Winner: Edison - WB6IQN

Ed – WB6IQN in his radio room testing out the Yaesu FT897D Transceiver

Wow!!! What a surprise that was? After 22 years I finally won the grand prize. I thought I was jinxed. It was worth the wait. I knew there was a reason why I have not bought an HF radio in the last 15 years. Thank you all for participating in the CARC raffle all these years.

The Yaesu FT897D transceiver is great. It has everything you need in radio. Covering HF to UHF and all modes and even modes I have never heard of. CW narrow band filters are included in the DSP processor. DSP noise reduction and DSP notch filtering. CW keyer and memory are built in. Wow, what a treat? It's going to take me the next year just to learn how to use this thing.

Maybe in the future, I will give talk on this radio and how to operate it. The menu system is similar to its little brother, the Yaesu FT817D QRP radio. The Yaesu FT897D transceiver will be great for Field Day, camping, mobile and is completely portable with its optional built in rechargeable battery pack. I'm sure I will get decades of enjoyment out of this terrific radio.

I have been having fun working CW and listening to DX the last few weeks. I'll wait for the next DX contest to jump in with this radio, until then I can hardly wait for the opportunity.

Theoretically, I can sell my entire shack (even my HP9591 spectrum analyzer) and just keep the Yaesu FT897D transceiver, but I won't for nostalgic reasons. That radio sure looks small compared to my Collins S line and Drake TR7A. Again thanks to everyone that participated.

Ed Fong

Public Service Announcements

Oakland Radio Communication Association (ORCA) meeting announcement.

Edison Fong (WB6IQN) will be making a presentation on antennas at the April ORCA meeting.

The meeting will be held on 9:00 AM Saturday April 6, 2013 at the Fire Station #1, Media Room, 1605 Martin Luther King at 17th Street, Oakland.

HAM CRAM / HAM Licensing

For upcoming HAM Licensing locations please refer to:
http://www.arrl.org/find-an-amateur-radio-license-exam-session

Bart Lee – K6VK

Attention all HAM, it is MayDay!!

The California Historical Radio Society (CHRS) and its amateur radio station W6CF is caught up in its landlord's bankruptcy (Inner Cities Broadcasting). This forces CHRS to purchase the Berkeley KRE building and property now or lose it.

UPDATE
THE NEWS WE HAVE BEEN WAITING FOR SINCE JUNE IS HERE. CHRS ENJOYS A LONG STANDING RELATIONSHIP WITH ONE OF THE BIDDERS AND POTENTIAL NEW OWNER OF KVTO. CHRS HAS A ROCK SOLID AGREEMENT WITH THIS BIDDER TO PURCHASE KRE IF THE BID PREVAILS. THIS IS THE CLOSEST WE HAVE BEEN TO OWNING KRE. WE WILL GET THE OK TO PURCHASE KRE BY NOVEMBER 9TH OR SOONER. AS SOON AS WE GET THE OK, WE WILL CALL FOR YOU TO FULFILL YOUR PLEDGES.

TODAY'S UPDATE – February 23rd – We started with $93,000 in our Museum Fund June 1st, and today we have 254 donations and pledges totaling $682,420! THANK YOU! Our goal is $750,000+. We only have $67,580 to go! Holy Cow, we have already raised nearly three quarters of a million dollars! It's downhill from here. We have done so well, please dig deeper and make this happen! We should be able to raise the rest with your help and support.

THESE EVENTS DO NOT MEAN AN END TO OUR FUNDRAISING BY ANY MEANS. WE ARE AWARE THAT SOME OF YOU MAY NOT BE ABLE TO FULFILL YOUR PLEDGES, SO

OTHERS MUST STEP AND PLEGDE FOR THE FIRST TIME OR INCREASE YOUR PLEDGES. WE ALSO HAVE INSURANCE, OPERATING COSTS AND FUTURE EXPANSION PLANS FOR KRE TO CONSIDER. PLEASE PLEDGE NOW. WE HAVE AMAZED THOSE OUTSIDE OF CHRS FOR OUR ABILITY TO REALIZE ALMOST ALL OF OUR GOALS IN A VERY SHORT TIME. WE KNOW THAT YOUR SUPPORT AND THE SUPPORT OF OTHER ORGANIZATIONS HAS BEEN TREMENDOUS. WE WILL BE ABLE TO DO THIS, WITH YOUR HELP.

MANY OF YOU HAVE ASKED TO BE MADE AWARE OF WHEN WE ARE GETTING CLOSE TO OUR GOAL SO YOU COULD INCREASE YOUR PLEDGES. NOW IS THAT TIME. THE PUSH IS ON. SO, PLEASE DIG DEEPER AND REMEMBER THE THOUSANDS OF HOURS OF SWEAT THAT YOUR CHRS BROTHERS AND SISTERS HAVE PUT INTO THIS PROJECT. WE KNOW THERE ARE MANY PEOPLE READING THIS WHO HAVE NOT PLEDGED. WE ARE VERY CLOSE. YOUR PLEDGE WILL MAKE A DIFFERENCE. IF YOU HAVE THOUGHT ABOUT MAKING A PLEDGE, DON'T HESITATE. DO IT NOW AND BE PART OF THIS IMPORTANT EFFORT.

REMEMBER – You can pledge now, but you need not send any funds until we need them. CLICK HERE TO PLEDGE.

SUPER DONORS – The list keeps growing. Be part of it! EVERY pledge and donation means a great deal to CHRS. But it is worth noting several pledges / donations that are really helping us to reach our goal:

Jack Bethards	– $5,000	Bert Buss	– $5,000
Elmo & Kim Giovanetti	– $5,000	Chip Lim	– $5,000
Tom Nelson	– $25,000	Robert & Reina Swart	– $5,000
Judy Mears & Bart Lee	– $10,000	Norm Howard Lehfeldt	– $15,000
Larry & Joan Drees	– $16,600	Tom & Julie Bonomo	– $25,000
George Patterson	– $25,000	Gilles Vrignaud	– $25,000
Norman Leal	– $75,000	Philip Monego	– $100,000
Scott Robinson	– $100,000	John Staples	– $100,000

Organization Donors of note:

The CHRS Central Valley Chapter – $3750 The Alabama Historical Radio Society – $1000
The SF Bay Area SBE Chapter 40 – $1000 The Sacramento SBE Chapter 43 – $1000
The Mt. Diablo Amateur Ra dio Club – $1000 The Delaware Valley Historic Radio Club – $1000
The Art Deco Society of California – $500 The Iowa Antique Radio Club and Historical Society – $500

We are grateful to these fine organizations for their support! And we need more support… Our $25,000 Challenge Pledge from Gilles Vrignaud towards our KRE building purchase fund is complete! Thank you Gilles and all who pledged during this challenge. The challenge and matching pledges were worth $50,000! – Who will step it up and offer a $50,000 Challenge next?

That is potentially worth $100,000 and puts us very close to our goal. So, if you have not

pledged, do it now! Many people have recently increased the size of their pledges. You can do the same and we would really appreciate it.

All donations to the CHRS are tax deductible and will be for the good cause of preserving the KRE building.

KRE 2012 - after CHRS Restoration

For additional information see: http://www.californiahistoricalradio.com/

Auxiliary Communications Service (ACS) - Tony Halog (KR6EG), ACS Chief

The Auxiliary Communications Service (ACS) was organized by the San Francisco Office of Emergency Services (OES) following the 1989 Loma Prieta Earthquake to support the communications needs of the City and County of San Francisco when responding to emergencies and special events.

The Auxiliary Communications Service holds General Meetings on the third Tuesday of each month at the San Francisco Emergency Operations Center, 1011 Turk Street (between Gough Street and Laguna Street), from 1900 hours to 2100 hours local time. All interested persons are welcome to attend.

The ACS Net begins at 1930 hours (7:30 p.m.) local time each Thursday evening, on the WA6GG repeater at 442.050 MHz, positive offset, tone 127.3 Hz. The purpose of this net is to practice Net Control skills, practice checking in with deployment status in a formal net, and to share information regarding upcoming ACS events. Guests are welcome to check in. ACS Members should perform Net Control duty on a regular basis. On the second Thursday of each month, the net will be conducted on the output frequency of the WA6GG repeater, 442.050 MHz no offset, tone 127.3 Hz, simplex.

For more information, please attend an ACS meeting or check in on a net, or call 415-558-2717.

Upcoming meetings: Tuesday 7pm, March 19, 2013
Tuesday 7pm, April 16, 2013
Tuesday 7pm, May 21, 2013

Gilbert Gin (KJ6HKD)

Free Disaster Preparedness Classes In Oakland:
http://www.oaklandnet.com/fire/core/index2.html

CORE is a free training program for individuals, neighborhood groups and community-based organizations in Oakland. The underlying premise is that a major disaster will overwhelm first responders, leaving many citizens on their own for the first 72 hours or longer after the emergency.

If you have questions about the recertification process, you may contact the CORE Coordinator at 510-238-6351 or core@oaklandnet.com.

Free Disaster Preparedness Classes In San Francisco – NERT Taught by San Francisco Fire Department

RSVP to sffdnert@sfgov.org or call 415-970-2024 to register. Visit www.sfgov.org/sffdnert to learn more about the training, other locations, and register on line.

Upcoming Special NERT Events.

March

5th: ICS Forms workshop - Using NERT ICS forms 7:00pm-8:30pm, SFFD DOT*
Register: http://www.eventbrite.com/event/5289224212#

9th: Disaster Operations 1
Learn how to put ICS into practice. 8:30am-3:30pm, SFFD DOT*
Register: http://www.eventbrite.com/event/5018015018#

16th: St. Patrick's Day Parade (NERT marching Unit)
Meet at 2nd and Market Street at 10:30am.
The NERT Unit will be directly behind the Firefighters Local 798
Register: http://www.eventbrite.com/event/4801285775#

16th: DART Training I - Animal Rescue Training With the Animal Care & Control Dept.
9am-1pm, SFFD DOT*
This is session 1 of 4. You must begin with this session and complete all in order.
NERT Certification or equivalent required to register,
email Dr. Bing Dilts: Dr.Bing.Dilts@sfgov.org

23rd: Disaster Operations 2
Prerequisite: NERT and Disaster Operations 1. 8:30am-3:30pm, SFFD DOT*
Register: http://www.eventbrite.com/event/5018063162#

April

3rd: ICS Forms workshop - Using NERT ICS forms. 7:00p-8:30pm, SFFD DOT*
Register: http://www.eventbrite.com/event/5018115318#

6th: Staging area drill
Put your ICS to practice. This is great preparation for the April drill on April 20th.
8:30am-1:00pm, SFFD DOT*
Register: http://www.eventbrite.com/event/5018317924#

13th: DART II - 9:00am-1:00pm, SFFD DOT*
This is session 2 of 4. See March 16th for registration requirements and details

20th: NERT Citywide drill - SAVE THE DATE

27th: DART III - 9:00am-1:00pm. SFFD DOT
This is session 3 of 4. See March 16th for registration requirements and details

May

4th: Intro to Ham Communications Team (HCT) 101, 8:30 a.m. - 3:30 p.m., SFFD DOT*
New or interested HAM operators beginner course (no license required)
HAM operators that want disaster communication instruction are welcome after lunch

7th: Ham Radio for "dummies", HCT 300 & 301, 6:30pm-9:00pm, SFFD DOT*
Get to know your radio. Basic how to instruction: turning on, tuning in, changing batteries etc. (Amateur Radio license required)

8th: Ham Emergency Messaging for the non-hobbyists (hobbyists allowed),
HCT 303, 6:30pm-9:00pm, SFFD DOT*
Learn and practice creating emergency messages (an important skill for ALL NERTS) and practice talking on the radio. Overcome your hesitation and just do it.

9th: Advanced Ham Radio for "dummies" Ham Communications Team (HCT) 400
Hands on training, 6:30pm-9:00pm, SFFD DOT*
Bring your radio and practice, practice, practice: buttons, antennas and tones etc. (Amateur Radio license required)

11th: DART IV, Animal Rescue Team Exercise, 9:00am-4:00pm, ACC, 15th and Harrison
This is session 4 of 4. See March 16th for registration requirements and details

16th: Neighborhood Coordinator/Leadership College, 8:30am-4:00pm, SFFD DOT*

* SFFD DOT is the Division of Training @ 19th Street/Folsom. (enter through yard on 19th and park along back wall) Division of Training classroom is in the 1-story building directly next to the Fire Station on the corner

San Francisco Police Department: Auxiliary Law Enforcement Response Team(ALERT)

The Auxiliary Law Enforcement Response Team (ALERT) is a citizen disaster preparedness program designed. The ALERT program is for volunteers 16 years of age or older, who live, work, or attend high school in San Francisco.

Graduates of the San Francisco Police Activities League (P.A.L) Law Enforcement Cadet Academy are also eligible to join.

ALERT volunteers will first complete the Fire Department's Neighborhood Emergency Response Team (NERT) (www.sfgov.org/sfnert) training and then graduate into an 8 hour Police Department course specifically designed for ALERT team members.

ALERT members will work closely with full-time and/or Reserve Police Officers in the event they are deployed after a disaster. The Basic ALERT volunteer will have no law enforcement powers other than those available to all citizens.

As part of their commitment, community members volunteering as an ALERT member will be required to attend two drills per year to maintain their program status and certification.

Every two years, the ALERT member will be required to attend an update course.

ALERT Training

The first ALERT training class has been scheduled for Saturday, April 13th, 2013. The class will be held at the San Francisco Police Academy, in the parking lot bungalow, from 8am-5pm (one hour lunch break).

IMPORTANT- All ALERT participants must complete the background interview process in order to be eligible to attend the ALERT training class.

Eligible ALERT participants may register for the April 13th training class by contacting the ALERT Program Coordinator, Mark Hernandez, at sfpdalert@sfgov.org, or by telephone at 415-401-4615.

* To register for the training class please email sfpdalert@sfgov.org with your NAME and PHONE NUMBER.

ALERT INFORMATIONAL MEETING:

An informational meeting will be held at the San Francisco Police Academy, located at 350 Amber Drive, Parking lot bungalows, on Thursday, March 28, 2013, at 7pm. All members of the public are welcome. Interested individuals will have their questions about the program answered

at the meeting.

For more information on the San Francisco Police Department ALERT Program, email us at sfpdalert@sfgov.org, or call Sergeant Mark Hernandez (SFPD, Ret.), SFPD ALERT Program Coordinator, at (415) 401-4615.

For additional information on the web please refer to: http://sf-police.org/index.aspx?page=4019

Featured Tech Article:

Peel-and-stick solar panels

http://engineering.stanford.edu/news/peel-stick-solar-panels-stanford-engineering

Wednesday, December 19, 2012

Decal-like application process allows thin, flexible solar panels to be applied to virtually any surface from business cards to roofs to window panes.

By Glen Martin

For all their promise, solar cells have frustrated scientists in one crucial regard – most are rigid. They must be deployed in stiff and often heavy fixed panels, limiting their applications. So researchers have been trying to get photovoltaics to loosen up.

The ideal: flexible, decal-like solar panels that can be peeled off like band-aids and stuck to virtually any surface, from papers to window panes.

Now the ideal is real. Stanford researchers have succeeded in developing the world's first peel-and-stick thin-film solar cells.

The advance is described in a paper in the December 20th issue of Scientific Reports.

Unlike standard thin-film solar cells, peel-and-stick thin-film solar cells do not require any direct fabrication on the final carrier substrate. This is a far more dramatic development than it may initially seem.

All the challenges associated with putting solar cells on unconventional materials are avoided with the new process, vastly expanding the potential applications of solar technology.

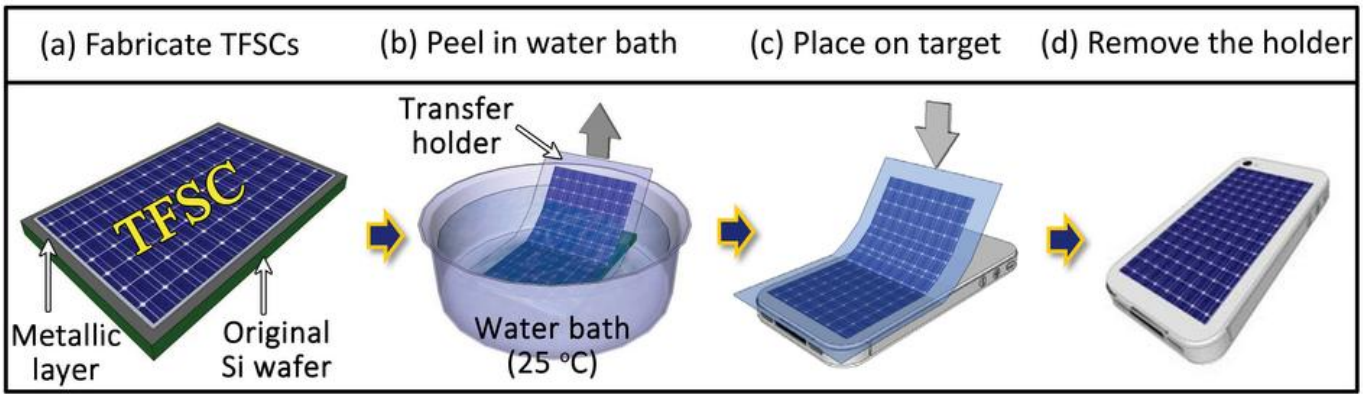
Thin-film photovoltaic cells are traditionally fixed on rigid silicon and glass substrates, greatly limiting their uses, says Chi Hwan Lee, lead author of the paper and a PhD candidate in mechanical engineering.

And while the development of thin-film solar cells promised to inject some flexibility into the technology, explains Xiaolin Zheng, a Stanford assistant professor of mechanical engineering and senior author of the paper, scientists found that use of alternative substrates was problematic in the extreme.

Assistant Professor of Mechanical Engineering Xiaolin Zheng (Photo: John Todd)

Doctoral candidate Chi Hwan Lee.

Figure 1: Procedures of the peel-and-stick process.



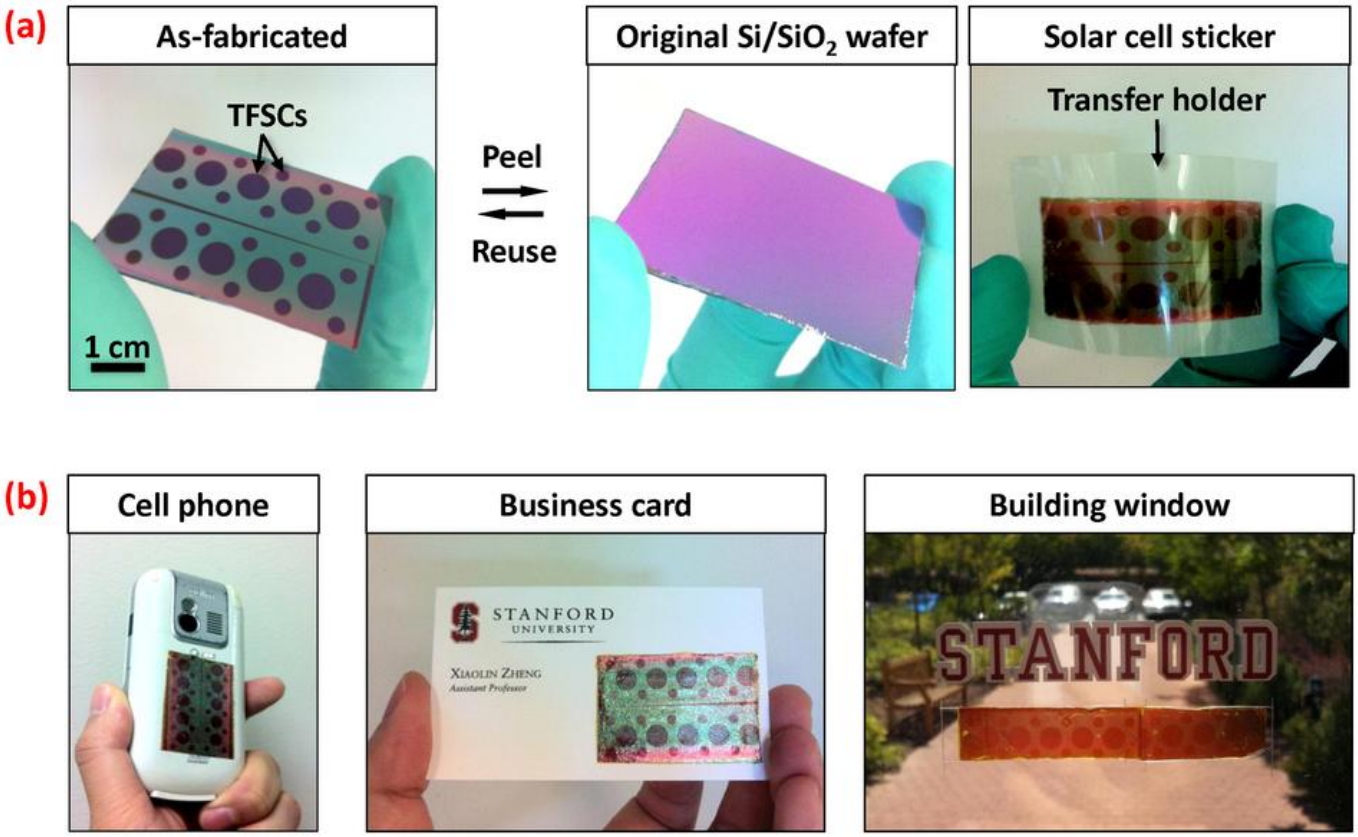
(a) As-fabricated TFSCs on the original Si/SiO_2 wafer.

(b) The TFSCs are peeled off from the Si/SiO_2 wafer in a water bath at room temperature.

(c) The peeled off TFSCs are attached to a target substrate with adhesive agents.

(d) The temporary transfer holder is removed, and only the TFSCs are left on the target substrate.

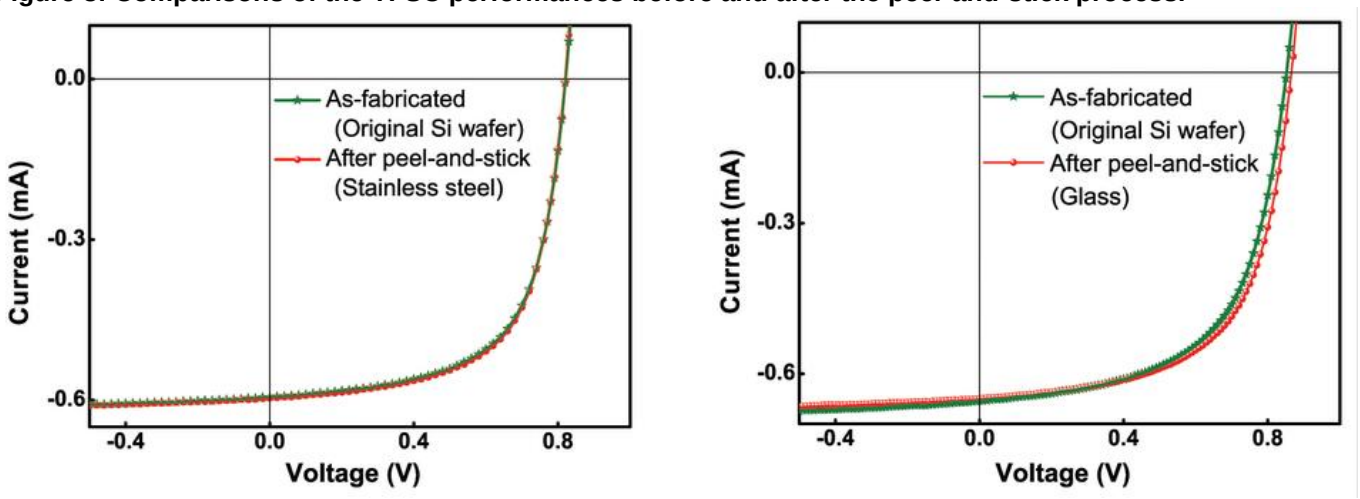
Figure 2: TFSCs at different stages of the peel-and-stick process.



(a) As-fabricated TFSCs on the original Ni coated Si/SiO_2 wafer (left). The donor Si/SiO_2 wafer is clean and reusable after the peeling-off step (middle). The TFSCs are held by a temporary transfer holder (right).

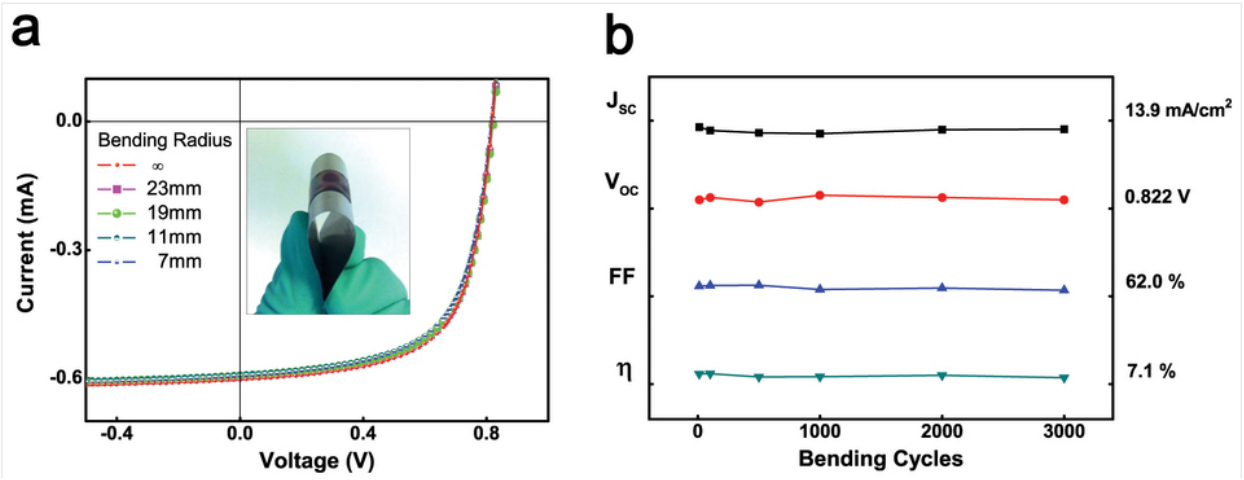
(b) TFSCs on cell phone (left), business card (middle), and building window (right).

Figure 3: Comparisons of the TFSC performances before and after the peel-and-stick process.



The representative I–V characteristics (below average performance) of the as-fabricated TFSCs (green lines with stars) are the same as those after transferring the TFSCs (red lines with dots) to stainless steel (left) and soda-lime glass (right).

Figure 4: Mechanical flexibility of the transferred TFSCs.



(a) The I–V characteristics of the TFSCs remain the same after bending the flexible sheet with a range of bending radius from 8 down to 7 mm. (b) The flexible TFSCs show no performance change over 3000 cycles of bending with bending radius about 10 mm. Note that all the I–V characteristics are measured when the TFSCs are flat to prevent any damage from the sharp tungsten probe tips during the measurements.

Nonconventional or ‘universal’ substrates are difficult to use for photovoltaics because they typically have irregular surfaces and they don’t do well with the thermal and chemical processing necessary to produce today’s solar cells,” Zheng says.

“We got around these problems by developing this peel-and-stick process, which gives thin-film solar cells flexibility and attachment potential we’ve never seen before, and also reduces their general cost and weight.”

Utilizing the process, researchers attached thin-film solar cells to paper, plastic and window glass, among other materials.

“It’s significant that we didn’t lose any of the original cell efficiency,” says Zheng.

The new process involves a unique silicon, silicon dioxide and metal “sandwich.” First, a 300-nanometer film of nickel (Ni) is deposited on a silicon/silicon dioxide (Si/SiO2) wafer.

Thin-film solar cells are then deposited on the nickel layer utilizing standard fabrication techniques, and covered with a layer of protective polymer.

A thermal release tape is then attached to the top of the thin-film solar cells to augment their transfer off of the production wafer and onto a new substrate.

The solar cell is now ready to peel from the wafer. To remove it, the wafer is submerged in water at room temperature and the edge of the thermal release tape is peeled back slightly, allowing water to seep into and penetrate between the nickel and silicon dioxide interface.

The solar cell is thus freed from the hard substrate but still attached to the thermal release tape. Zheng and team heat the tape and solar cell to 90°C for several seconds, and the cell can then be applied to virtually any surface using double-sided tape or other adhesive.

Finally, the thermal release tape is removed, leaving just the solar cell attached to the chosen substrate.

Tests have demonstrated that the peel-and-stick process reliably leaves the thin-film solar cells wholly intact and functional, Zheng says. “There’s also no waste.

The (Si) wafer is typically undamaged and clean after removal of the solar cells, and can be reused.”

While others have been successful in fabricating thin-film solar cells on flexible substrates before, those efforts have required modifications of existing processes or materials, notes Lee.

“The main contribution of our work is that we have done so without modifying any existing processes, facilities or materials, making them viable commercially.

And we have demonstrated our process on a more diverse array of substrates than ever before," Lee says.

"Now you can put them on helmets, cell phones, convex windows, portable electronic devices, curved roofs, clothing – virtually anything," says Zheng.

Moreover, peel-and-stick technology isn't necessarily restricted to thin-film solar cells, Zheng said. The researchers believe the process can also be applied to thin-film electronics, including printed circuits, ultra thin transistors and LCDs.

"Obviously, a lot of new products – from 'smart' clothing to new aerospace systems – might be possible by combining both thin-film electronics and thin-film solar cells," observes Zheng. "And for that matter, we may be just at the beginning of this technology.

The peel-and-stick qualities we're researching probably aren't restricted to Ni/SiO2. It's likely many other material interfaces demonstrate similar qualities, and they may have certain advantages for specific applications. We have a lot left to investigate."

The authors of the *Scientific Reports* paper – "Peel-and-Stick: Fabricating Thin Film Solar Cell on Universal Substrates" – are Chi Hwan Lee, In Sun Cho and Xiaolin Zheng from Stanford's Department of Mechanical Engineering, Dong Rip Kim from Hanyang University in Seoul, Korea, and Nemeth William and Qi Wang from the National Renewable Energy Laboratory in Denver, Colorado.

Glen Martin is a freelance writer working for the Stanford University School of Engineering.