Power in System on Chip Needs a New Energy Storage Solution

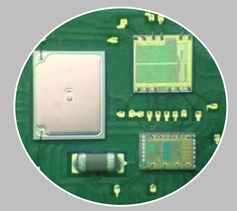
INDUSTRY TRENDS AND CURRENT SOLUTIONS ARE MISALIGNED

INCREASING PROLIFERATION OF ELECTRONIC DEVICES THAT ARE SMALLER, PORTABLE AND/OR CONNECTED

Ultra-Low Power Electronics

Wireless Smart Devices & Sensors Everywhere

Component Integration and Miniaturization



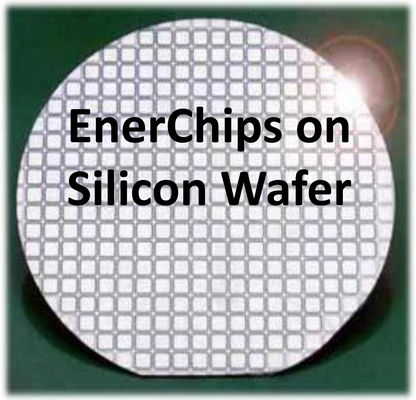
Life of Product Batteries

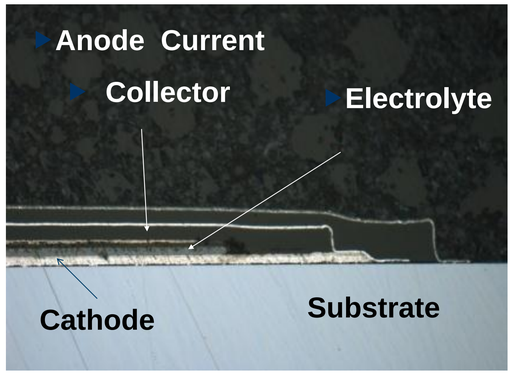
Key Trends Driving Billions of New Devices

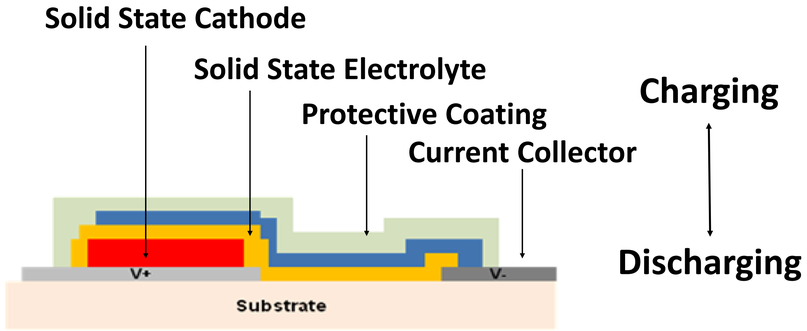
HOWEVER, EXISTING ENERGY STORAGE SOLUTIONS ARE INADEQUATE

- LARGER PROFILE / BULKY SIZE
- LOW ENERGY FOR SPACE USED
- INTEGRATION ISSUES
- HIGH WEAR-OUT AND FAILURE ISSUES
- TOXIC CHEMICALS – SAFETY AND DISPOSAL ISSUES

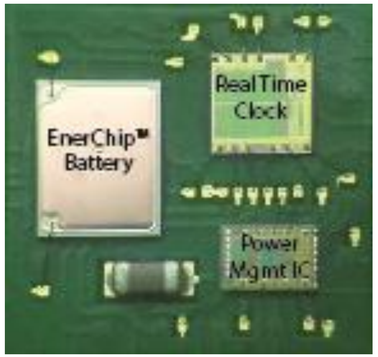
Cymbet EnerChip™ Solid State Battery Technology







EnerChip RTC Co-packaged
Battery + RTC + PMIC

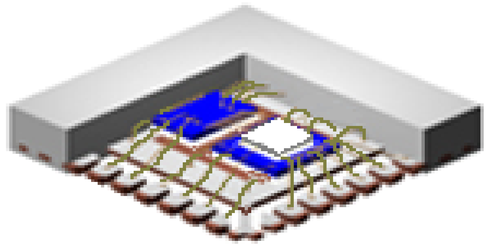


- Solid State Rechargeable Batteries in various shapes and capacities
- Produced using semiconductor fab processes on silicon wafers
- Cathode is LiCO2, solid electrolyte is LiPON, Anode is Lithium-free
- Simple and quick 4.1V charging with >5000 charge cycles
- EnerChip battery bare die use standard wirebonds and gold stud bumps
- EnerChips are JEDEC-standard solder reflow tolerant

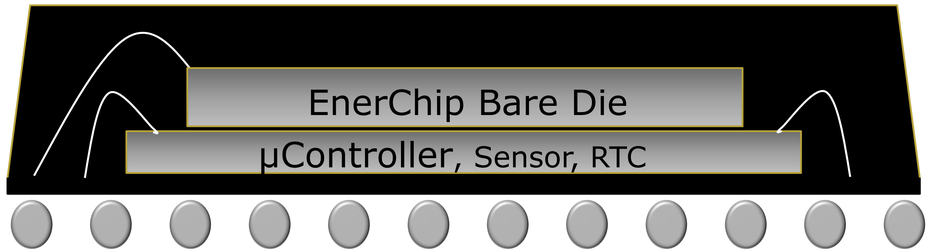
Embedding Solid State Batteries in System on Chip

- Bare die batteries for integration into co-packaged devices and tiny modules.
- Various configurations :
  - Side-by-Side wirebond
  - Stacking – waterfall or wedding cake
  - Bumped Flip-Chip, Chip over Chip
  - Mixed attachments in System on Chip
- Applications
  - Medical Devices
  - Wearable Technology
  - Internet of Things Wireless Sensors
  - Healthcare and Fitness
  - Tamper Detection and Security

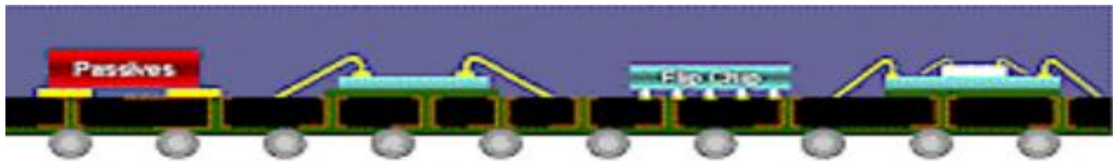
Side-by-Side EnerChip and ICs with Wire Bond



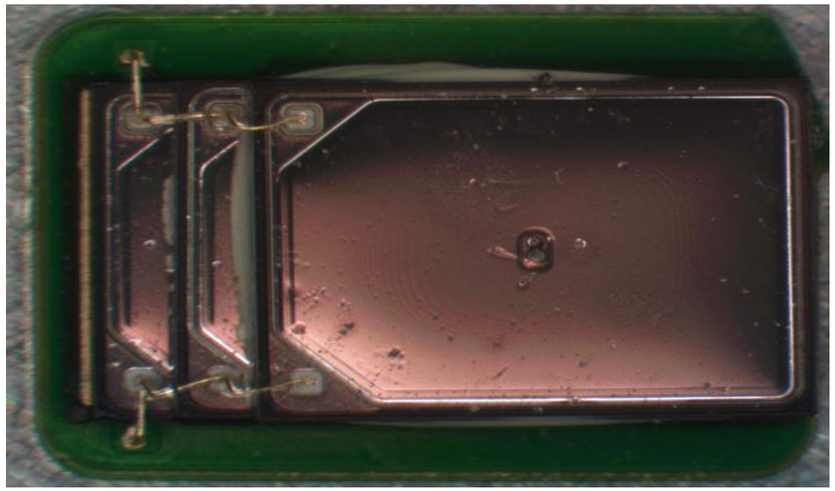
Stacking EnerChip and ICs using Wire Bond



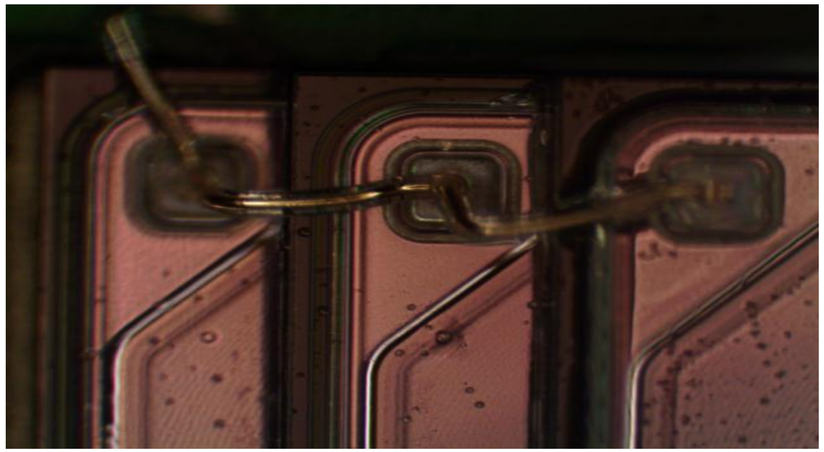
EnerChip and ICs in System On Chip

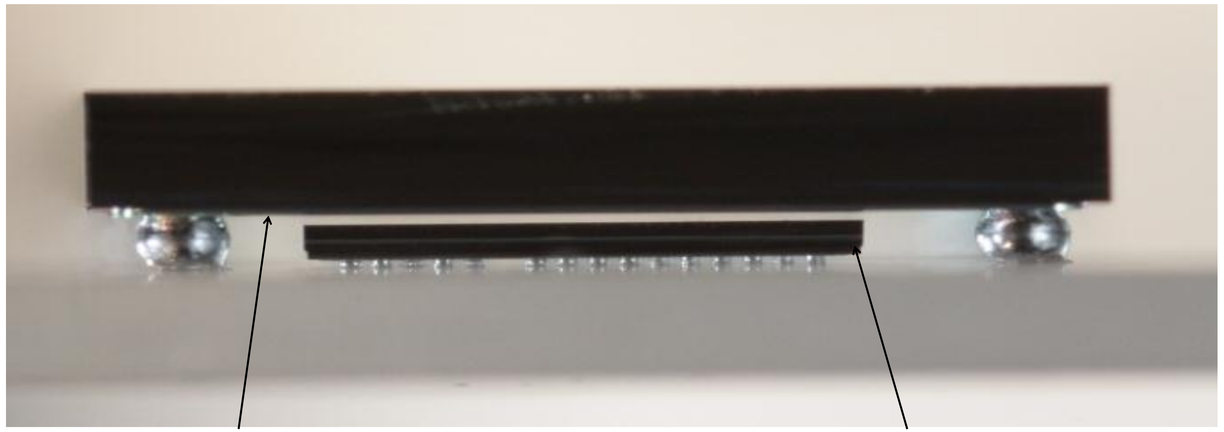


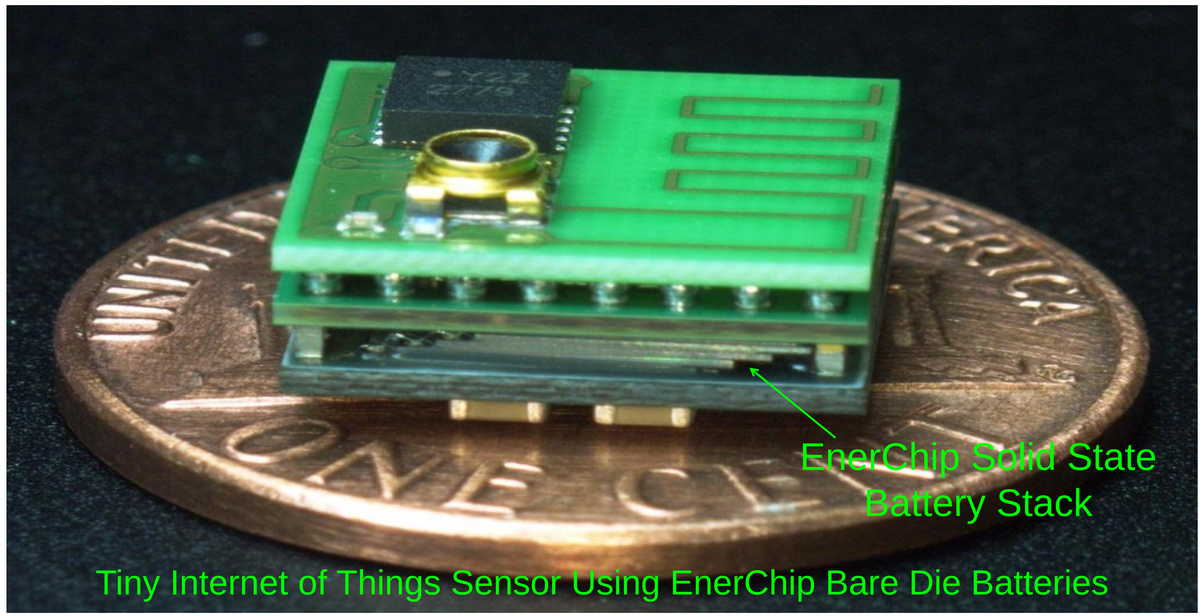
Solid State Bare Die Stacking and Assembly Examples



Three Stack Waterfall Wire bond
700 micron height



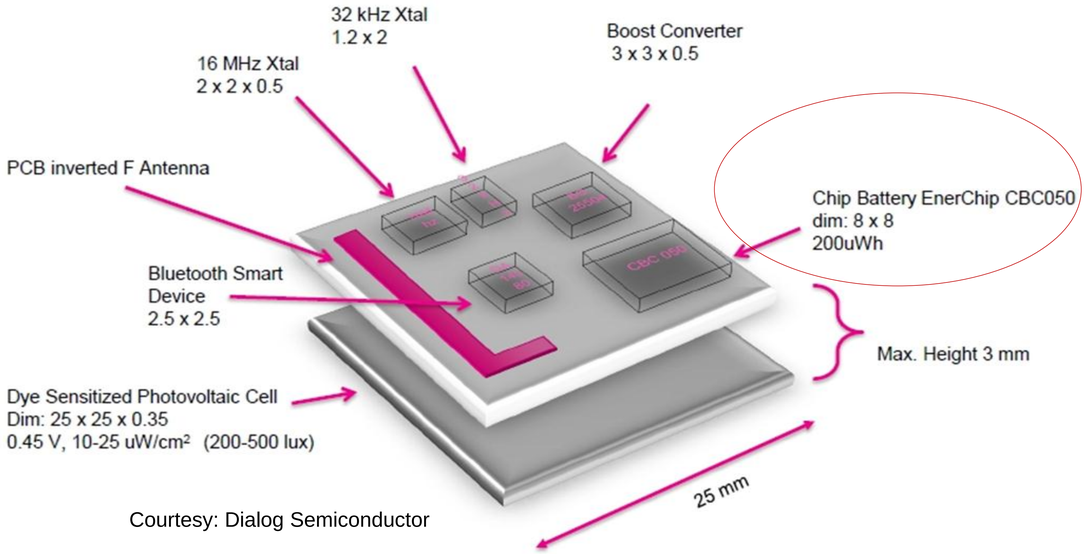




Integrated Battery in Module Concepts – Bluetooth Smart, RFID, NFC

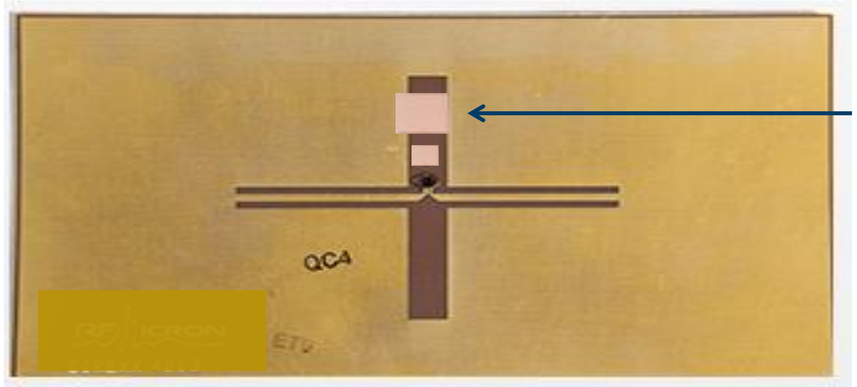
- A Bluetooth Smart beacon with a miniature solar panel that runs on room light

- Works for 2-3 hrs in the dark
- 50 hours in standby
- > 3 connections/sec at 200-500 Lux
- Chip battery charges in less than 2 hours
- Dialog Bluetooth Smart (DA14580) uses < 20 uJ/Connection

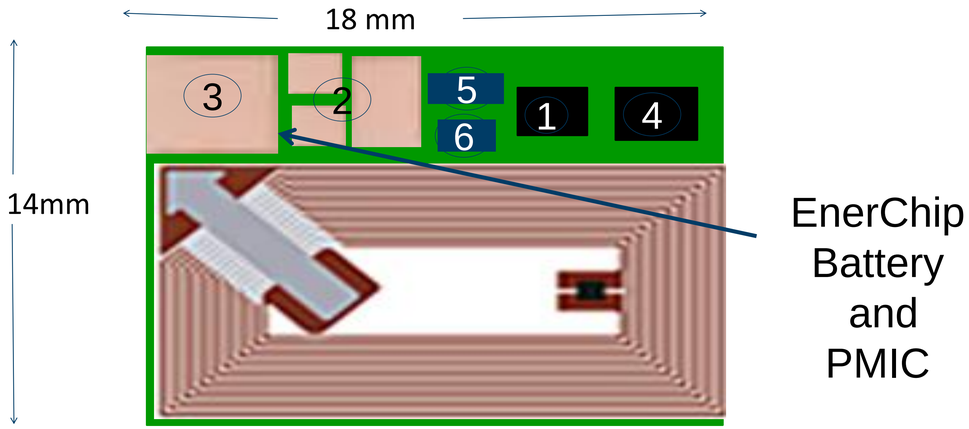


Courtesy: Dialog Semiconductor

EnerChip Powered Active RFID Tag with Bare Die



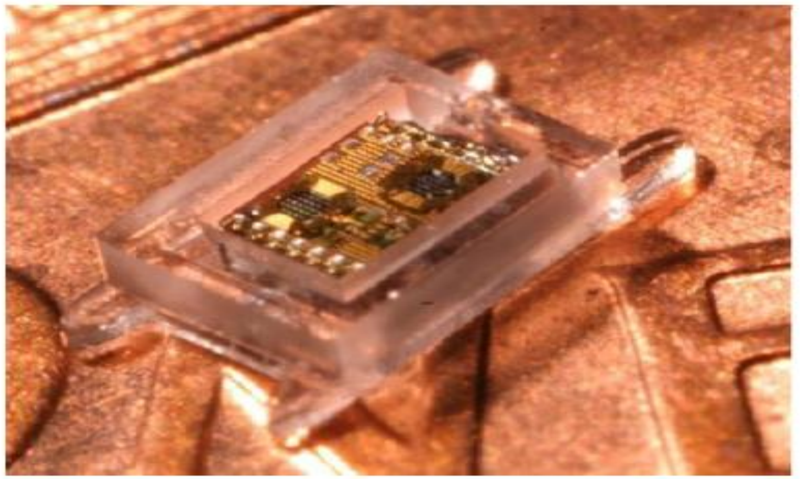
EnerChip Powered IoT NFC Sensor Tag

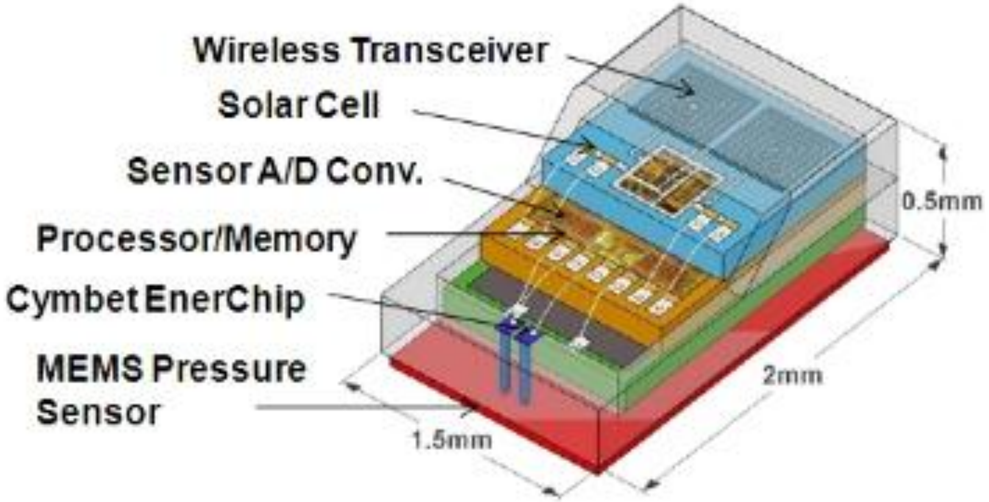


100% Non-Cytotoxic Solid State Batteries Ideal for Medical SiPs and SoCs

The gamma sterilized Cymbet EnerChip™ bare die batteries were found to be non-cytotoxic (0% cell lysis) using both the Medium Eluate Method Eluation Test and Agar Diffusion Test feasibility screening procedures. The lack of any adverse biological responses in these very sensitive in vitro cell culture assays is indicative (although not a guarantee) of biocompatible test results in the other in vitro and in vivo aspects of biocompatibility as suggested by the ISO 10993-1 and FDA G95-1 guidelines.

Intra Ocular Pressure Sensor For Glaucoma Patients





Courtesy: Univ. of Michigan