E-waste Derived Copper-based Catalysts Derived Toward Carbon-Neutral Electrochemical CO_2 Reduction

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More than 2 million tons of waste printed circuit boards have been generated each year all over the world. The traditional procedures for recycling precious metal from these circuit boards require extra procedures and energy with processes of crushing, sorting or incineration, high-temperature pyrolysis etc. E-wastes (unrecycled printed circuit boards, in particular) contain many metals such as gold, silver, copper, tin and iron, but conventional recycling procedures are not able to regenerate the value of inexpensive metals such as copper and tin, which are normally discarded. On the other hand, copper and tin have been suggested as potential catalysts in the electrochemical carbon dioxide reduction reaction (CO_2RR) that contributes to the “carbon-neutral” loop. Thus, in our work, we proposed that the substrates of circuit boards could be carbonized to form a conductive network to be adopted as catalysts and electrodes. By collecting circuit boards, breaking them apart, and dissolving them in acids, we collected Cu and tin species for electrochemical deposition to prepare copper-based catalysts with different Cu/Sn ratios. Those catalysts were used as electrodes for CO_2RR, exhibiting a great selectivity toward formic acid (with Faradaic efficiencies as high as 66%). Furthermore, the selectivity can be controlled by the variation of active metallic elements in the catalysts, then, the different products of CO_2RR can be obtained. This suggests the promising potentials of our “from trash to treasure” strategy to produce functional electrocatalysts from recycling industrial waste for environmental protection and valuable compound production.

Awards Won:

ASU Rob and Melani Walton Sustainability Solutions Service: Award of $1,000