

SMITH Lab – Leading the Way in E-Waste Recycling

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Electronic waste, or e-waste, refers to all items of electrical and electronic equipment and their parts that have been discarded as waste without the intent of re-use. E-waste contains both valuable and hazardous materials that require special handling and recycling methods.

The Global E-waste Monitor finds that by 2022, the world generated 62 billion kg of e-waste, or an average of 7.8 kg per capita. Only 22.3 per cent (13.8 billion kg) of the e-waste generated was documented as properly collected and recycled in an environmentally sound manner. The e-waste generated in 2022 contained 31 billion kg of metals, 17 billion kg of plastics, and 14 billion kg of other materials (minerals, glass, composite materials, etc.). The economic value of the metals contained in the e-waste generated globally in 2022 is estimated at USD 91 billion. Valuable secondary raw materials are copper (USD 19 billion), gold (USD 15 billion), and iron (USD 16 billion). These metals can be efficiently reclaimed with high recycling rates using current e-waste management technologies, implying that improved collection rates could substantially increase current value recovery rates.

India's journey to Viksit Bharat is being powered by a rapid digital transformation, with an increased reliance on electronic devices. From smartphones and laptop computers to modern industrial and medical equipment, technology has become the foundation for economic growth, connectivity, and innovation. However, this rising reliance on electrical devices produces a byproduct – e-waste, which must be properly managed to ensure long-term progress. India, being one of the world's leading e-waste generators (together with China, the United States, Japan, and Germany), faces a serious e-waste management challenge.

The Sustainable Metallurgy and Industrial Technologies (SMITH) Lab at IIT Hyderabad is at the forefront of developing sustainable technologies and circular economy research. Our mission is to develop efficient, eco-friendly, and scalable solutions for managing and recycling e-waste. We develop novel methods to recover critical metals from Printed Circuit Boards (PCBs) using sustainable techniques through critical thermodynamic and sustainability analyses, optimizing environmental factors such as the sustainability index, carbon emission index, and resource utilization efficiency. The SMITH lab also investigates chemical and thermal processes for recycling Liquid Crystal Displays (LCDs), aiming to recover indium, tin, and other valuable metals in an eco-friendly way. Indium concentrations in ore typically range from less than 1 ppm to 100 ppm. At the same time, the LCDs contain approximately 0.24%, which shows a potential for urban mining for these critical metals.

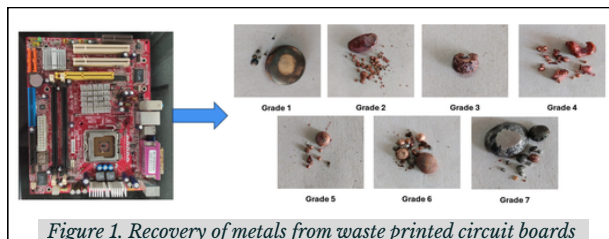
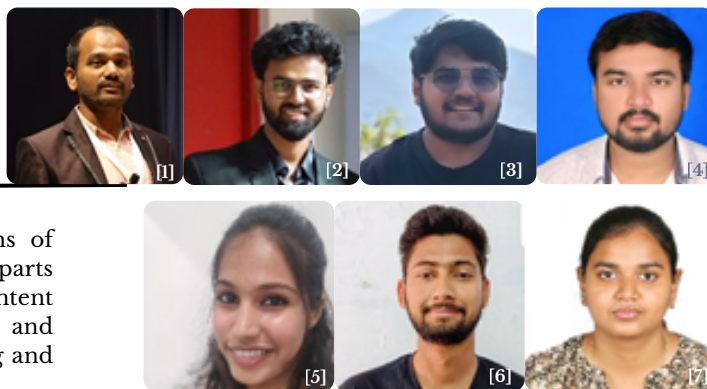


Figure 1. Recovery of metals from waste printed circuit boards from 7 grades.

Also, our lab is working on catalytic membranes to recover platinum and nickel, which are critical metals for our country, through innovative techniques, ensuring safe handling and minimal ecological impact.

Zerava Technologies Pvt Ltd. is a startup originating from the SMITH lab by Mr. Viraj Tank and Mr. Ajay Bachipalli, working on sustainable process development for the recovery of critical metals, rare earth elements, and precious metals from e-waste.

Zerava
Technologies Private Limited



Prof Veena Sahajwalla (UNSW, Sydney) visit to SMITH Lab



Prof Akbar Rhamdani (SUT, Melbourne) visit to SMITH Lab

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