Investigation of Advanced Techniques for Liberating Electronic Components for the Recycling of Printed Circuit Boards

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Waste electrical and electronic equipment (WEEE) represents a complex and rapidly growing waste stream, which reached 62 million tons worldwide in 2022. Printed circuit boards (PCBs) are critical parts of WEEE, hosting numerous different electronic components (ECs) that contain a variety of critical raw materials. Consequently, they represent a valuable material resource for recycling, playing a crucial role in fostering a genuine circular economy for electronics. As part of the Circular Circuits research program funded by NWO (Dutch Research Council), this study aims to develop a hydrometallurgical process to recover critical resources from ECs derived from a component-based sorting process. To pursue this approach, the ECs must first be liberated from the PCBs. Currently, there is no clean and industrialized solution for this. Therefore, this work examines various promising methods based on different principles. The first approach aimed to depolymerize the polymer matrix of the PCBs, thereby liberating the electrical circuit and its associated components. The reactant used was a mixture of organic solvents at ambient pressure and temperatures of up to 180 ^{0}C. Preliminary results showed the successful removal of epoxy resin on the surface. However, partial damage to the ECs was also observed, possibly affecting the downstream sorting process. Another technique aimed to electrochemically dissolve the solder alloy and simultaneously deposit tin on cathodes. Initial experiments in an acidic media at 40 ^{0}C and applied current density of 60 A/m^{2} showed the successful recovery of tin and detachment of ECs. However, further research is under way to investigate other methods for determining the most effective way to detach ECs from PCBs.