

Title: Green synthesis and characterization of gold nanoparticles from discarded computer PCBs on reduction of environmental pollution

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Abstract: The economic value of gold content in electronic waste, particularly waste printed circuit boards (PCBs), has generated interest in recovering gold from this material. Unfortunately, due to the severe environmental hazards associated with such waste, there is a pressing need for efficient and selective methods of gold nanoparticle recovery. A novel technique has been developed to synthesize gold nanoparticles that employ chlorate leaching and Punica granatum extract to minimize the environmental impact of electronic waste. Multiple analytical methods, including UV-Vis, XRD, EDS, SEM, and TEM analysis, were utilized to identify and characterize the extracted gold nanoparticles. The UV-Vis spectrum showed GNP-absorption peaks at a narrow range of wavelengths, primarily at 520 nm, confirming the formation of gold nanoparticles from the e-waste. The XRD analysis identified the material as metallic gold with characteristic peaks of gold crystals (111), (200), (220), and (311), corresponding to the FCC crystal structure. The SEM and TEM analysis revealed that most of the Au nanoparticles were less than 40 nm in size, with some larger particles resulting from the agglomeration of smaller ones. The EDS spectrum analysis indicated that the gold atoms emitted strong signals. At the same time, other elements such as carbon, oxygen, and metals such as Sn, Zn, Pd, Cu, and Cd showed weaker signals. The recovered gold nanoparticles were found to have a bandgap of 2.2 eV, indicating that they are a direct bandgap semiconductor suitable for use in optoelectronic applications. The environmental impact of the PCBs and the chemicals used in the process were also analyzed to address the necessity of using discarded electronic waste to reduce environmental pollution. The proposed method showed high efficiency for extracting gold nanoparticles from e-waste, with simple process steps, low chemical usage, and low cost, as demonstrated by the results.

Keywords: Optoelectronic applications, Environmental pollution, Environmental impacts, Printed circuit board, Energy dispersive X-ray spectroscopy, Scanning electron microscopy, X-ray diffraction, UV-visible spectroscopy, Nanoparticle

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