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<AT>Direct extraction of palladium and silver from waste printed circuit boards powder by supercritical fluids oxidation-extraction process

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<ABS-HEAD>Highlights► Ag and Pd from waste PCBs were directly extracted by a supercritical fluids oxidation-extraction process. ► Supercritical water oxidation was employed to enrich precious metals from waste PCBs. ► Supercritical carbon dioxide was used as eco-friendly solvent for precious metals recovery. ► Supercritical carbon dioxide extraction process for Ag and Pd recovery reduced organic solvent waste.

<ABS-HEAD>ABSTRACT

<ABS-P>The current study was carried out to develop an environmental benign process for direct recovery of palladium (Pd) and silver (Ag) from waste printed circuit boards (PCBs) powder. The process ingeniously combined supercritical water oxidation (SCWO) and supercritical carbon dioxide (Sc-CO_2) extraction techniques. SCWO treatment could effectively enrich Pd and Ag by degrading non-metallic component, and a precious metal concentrate (PMC) could be obtained, in which the enrichment factors of Pd and Ag reached 5.3 and 4.8, respectively. In the second stage, more than 93.7% Pd and 96.4% Ag could be extracted from PMC by Sc-CO_2 modified with acetone and KI-I_2 under optimum conditions. Mechanism study indicated that Pd and Ag extraction by Sc-CO_2 was a complicated physiochemical process, involving oxidation, complexation, anion exchange, mass transfer and migration approaches. Accordingly, this study established a benign and effective process for selective recovery of dispersal precious metals from waste materials.

<KWD>Keyword: Precious metals; Waste printed circuit boards; Supercritical water oxidation; Supercritical fluid extraction; Recovery

<H1>1.Introduction

In recent years, a more and more attention has been paid to the separation and purification of metal ions through supercritical fluid extraction (SFE) [1, 2]. The potential of CO_2 as a solvent for SFE is interesting as it is nontoxic, nonflammable, abundantly available, and recyclable, minimizing the problems associated with waste liquid [3, 4]. CO_2 is relatively stable. But when the temperature of CO_2 is higher than 31 °C and the pressure of CO_2 is more than 7.38 MPa, the CO_2 will be transformed into the supercritical state. The supercritical carbon dioxide (Sc-CO_2) is between gas and liquid and has the dual characteristics of gas and liquid, thus its density is close to that of