



## Industrial Consultancy & Sponsored Research (IC&SR)

### A SELECTIVE AND EFFICIENT PROCESS FOR THE EXTRACTION OF NOBLE METAL IONS FROM COMPLEX MIXTURES

#### IITM Technology Available for Licensing

#### Problem Statement

- Generally, the extraction of noble metals from minerals and their subsequent processing requires highly reactive conditions and toxic chemicals.
- There were few methods discussed related to recovery of gold and other precious metals including iron in the prior art of literatures, which were **more cost effective** and caused to water and soil pollution.
- The present invention overcomes the above-mentioned deficiencies by providing **environment-friendly** solution.

#### Technology Category/ Market

**Chemical Technology:** Extraction precious metal like gold, palladium and platinum and others;

**Industry:** Metal extraction plants, electronic waste, mining waste, wastewater treatment plant, and Electronics Industry

**Applications:** Jewelry, Catalyst, Electronics, Battery, others.

**Market:** The global precious metals recovery market was valued at USD 9.4 billion in 2021 and projected to reach USD **18.7** billion by 2030, growing at a **CAGR of 7%** from 2022 to **2030**.

#### Technology

- The present invention describes a **process** for **extraction of noble metal ions** comprising hereinbelow:

1. **Reaction** of styrene monomer with niacin at **90°C** with the presence of potassium persulfate and surfactant sodium dodecyl sulphate (SDS) in the *in situ* polymerization process produces **niacin-incorporated polystyrene**;

2. **Exposing** the noble metal containing **ionic mixture** to the niacin-incorporated polystyrene to form a **complex** and **separating the noble metal** adsorbed polystyrene-niacin complex;

3. a **polystyrene-niacin composite** selectively adsorbs noble metal ions from a solution from harsh industrial conditions with **pH 1 to 3**. Niacin is a biomolecule.

- The **noble metal** includes **Au, Pd, Rh, Pt, Ru, Ag, Ir** and etc..
- The aqueous medium contains various metals in ionic form with concentrations **10, 100 and 1000 times** than the noble metal ions present in the mixture.
- The polymeric adsorbent can be used with other technologies.

#### Intellectual Property

**IITM IDF Ref. 2339;**

**IN Patent No. 417781 (Granted);**

#### Key Features / Value Proposition

##### ❖ **Technical Perspective:**

1. Present invention is **selective, high cost effective** and **sustainable** for noble metal extraction using a **new functionalized niacin complex with polystyrene**.

2. Said materials could be used in a **wide range of pH conditions (1 to 7)** and **different concentration** of Au solution which is very low to very high concentration and ideal mining conditions (depicted in Figs and Tables 1 and 2).

##### ❖ **Industrial Perspective:**

1. Said functionalized niacin complex with polystyrene is **not water-soluble**, and could be used for industrial metal extraction such as **Au, Ag, Pd, Pt, Rh, Ru, etc.**, from the said complex mixture.

2. **Simple** and **green methodology** for extraction of **industrial metals** from ores, using soft Chemistry approach.

#### TRL (Technology Readiness Level)

**TRL- 3/4**, Proof of Concept Ready & tested, and validated in Laboratory.

#### Research Lab

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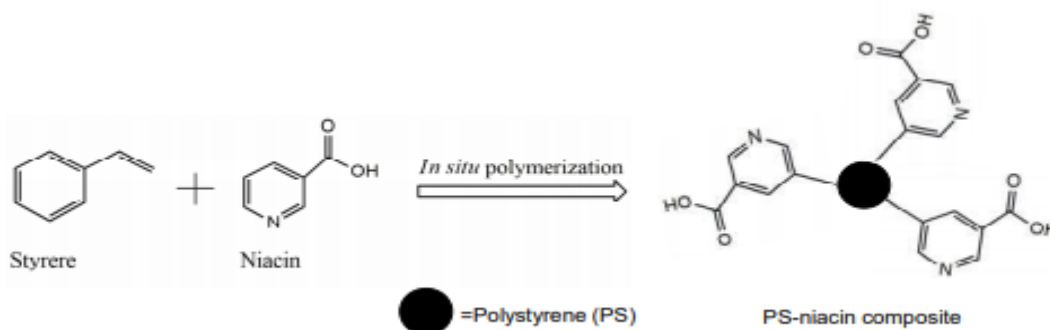
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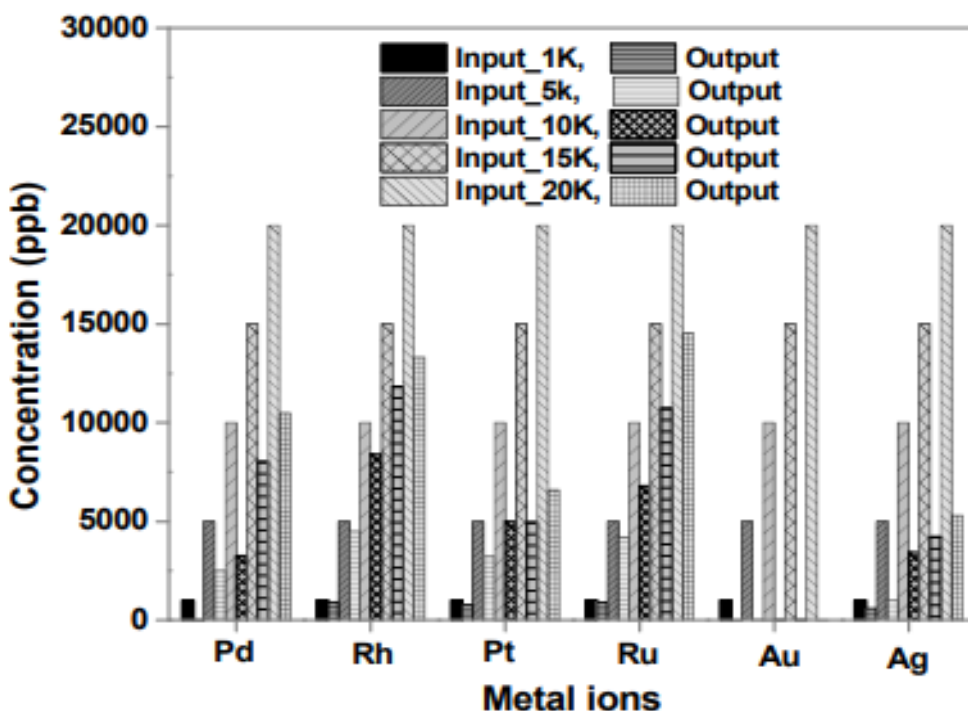
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#### Images



**Fig1:** Illustrates a schematic representation of synthesis of niacin-incorporated polystyrene (optimized composite X)



**Fig2:** Illustrates selective adsorption of different noble metals from a mixture with different input concentration

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