Nanonickel Derived From Nickel Spent Catalyst – Its Synthesis and Characterization

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Abstract : Nickel spent catalyst is an industrial waste materials disposed off in very large quantities causing environmental pollution. This paper deals with recovery of nickel from nickel spent catalyst for preparation of nanonickel. Nickel metal particles synthesized from nickel spent catalyst shows x-ray diffraction lines corresponding to the (111), (200), (220), (311), (222) planes of nickel standard powder diffraction pattern. Hysteresis loop obtained from vibrating sample magnetometry (VSM) reveal that the obtained nickel particles are possessing magnetic property.

I. INTRODUCTION:

Odisha has various kinds of mineral reserves such as iron ore, chromite ore, bauxite etc. Several mineral industries have grown in the state of Orissa to extract valuable materials for their utilization. On the other hand these mineral industries produce plenty of solid wastes which are often referred as tailings. Even after recycling of these tailings/waste produces considerable quantity of tailings which results in disposal problems. These wastes occupy huge area of land and causing environmental problems. Therefore, it is proposed to utilize these wastes to prepare value added materials for their magnetic and catalytic applications.

Nickel spent catalyst is an industrial waste materials disposed off in very large quantities causing environmental pollution. Here nickel was extracted as nickel sulfate solution by treating nickel spent catalyst with 1 M sulfuric acid at 90 °C. The obtained nickel sulfate solution was used as a starting source for preparation of nanonickel. X-ray powder diffraction (XRD) studies reveal that nickel spent catalyst has alumina as major phase and nickel oxide as minor phase. But the acid leached residue contains alumina and very minor quantity of silica phase. Absence of diffraction lines corresponding to nickel oxide phase in the XRD pattern of residue indicates that NiO present in the spent catalyst is leached out during sulfuric acid treatment.

II. METHODOLOGY :

It involves extraction of valuable metals from the mineral waste by acid digestion. Synthesis of metal/mixed metal oxide and hydroxide from acid extracted solution by chemical precipitate ion method. Surface modification of prepared metal oxides for the catalytic study. Nickel was extracted as nickel sulfate solution by treating nickel spent catalyst with 1 M sulfuric acid at 90 °C. The obtained nickel sulfate solution was used as a starting source for preparation of nanonickel.

III. DISCUSSION AND RESULTS :

a) XRD of nickel spent catalyst and its acid insoluble residue :

X-ray powder diffraction (XRD) studies reveal that nickel spent catalyst has alumina as major phase and nickel oxide as minor phase. But the acid leached residue contains alumina and very minor quantity of silica phase. This result has been shown in Figure 1

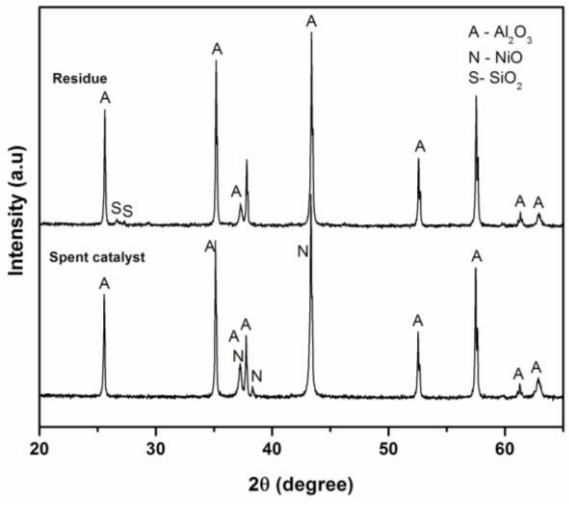

Figure 1. XRD of nickel spent catalyst and its acid insoluble residue

b) XRD of Nanonickel powder :

Absence of diffraction lines corresponding to nickel oxide phase in the XRD pattern of residue indicates that NiO present in the spent catalyst is leached out during sulfuric acid treatment. Nickel metal particles

synthesized from nickel spent catalyst shows x-ray diffraction lines corresponding to the (111), (200), (220), (311), (222) planes of nickel standard powder diffraction pattern. This result has been shown in Figure 2.

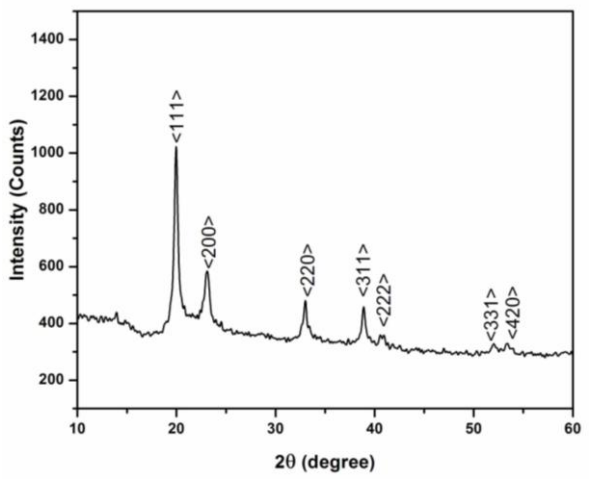

Figure 2. XRD of Nanonickel powder

c)VSM of Nanonickel powder :

Hysteresis loop obtained from vibrating sample magnetometry (VSM) reveal that the obtained nickel particles are possessing magnetic property. This result has been shown in Figure 3.

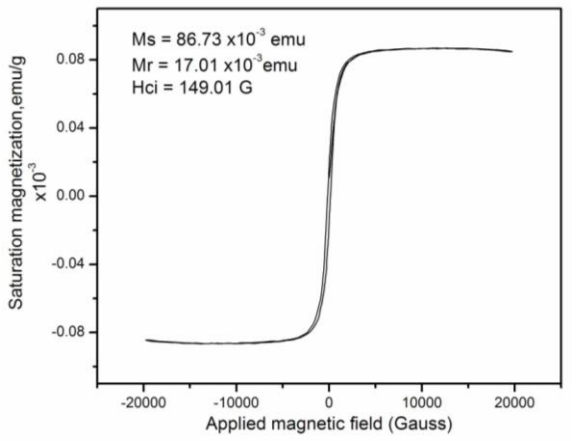

Figure 3. VSM of Nanonickel powder

IV. CONCLUSION :

The significance of this work lies on the preparation of value added materials from waste. The value added materials are magnetite, other iron oxide hydroxide and mixed oxides which are having potential magnetic and catalytic applications. It is possible to extract nickel from nickel spent catalyst through sulfuric acid leaching . Nanonickel powder having flower morphology could be synthesized via hydrazine reduction method. Nanonickel powder could be used as soft magnetic material.

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