

Preparation and Properties of Composites of Molybdenum Disulfide and Titanium Dioxide



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Introduction

- A semiconductor is a kind of material with similar properties of both an insulator and conductor.
- Molybdenum Disulfide is a 2-D Material with promising properties. Titanium Dioxide is a popular material used in modern electronics.

Focus of Study

The purpose is to observe and record the properties of composites of MoS₂ and TiO₂.

Experiment

1. Hydrothermal Method to Produce MoS₂

- A solution of MoS₃, Thioacetamide, Urea, and TiO₂ is prepared in autoclaves and MoS₂ is synthesized via extreme heat.
- The solutions are centrifuged in order to separate the MoS₂ and TiO₂ solution from other chemicals.

2. Subsequent Processing

- Substrates are made hydrophilic by a plasma generator. The solution of MoS₂ and TiO₂ is sprayed on the substrates.
- These substrates are now prepared for testing of various properties.

Materials Used in Experiment



Raman spectroscopy

- Used to analyze the components and structure of the substances by testing the chemical bonds of the atoms.
- Figure 1 shows the MoS₂, and Figure 2 shows TiO₂.

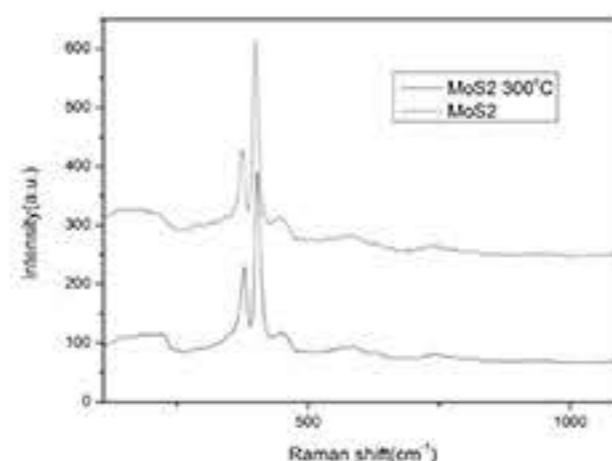


Figure 1- MoS₂

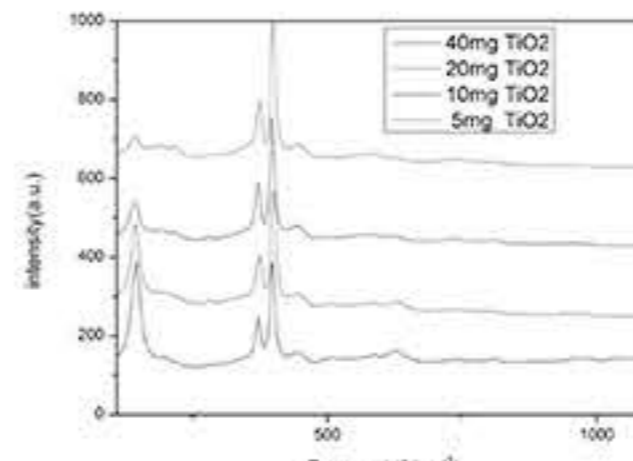
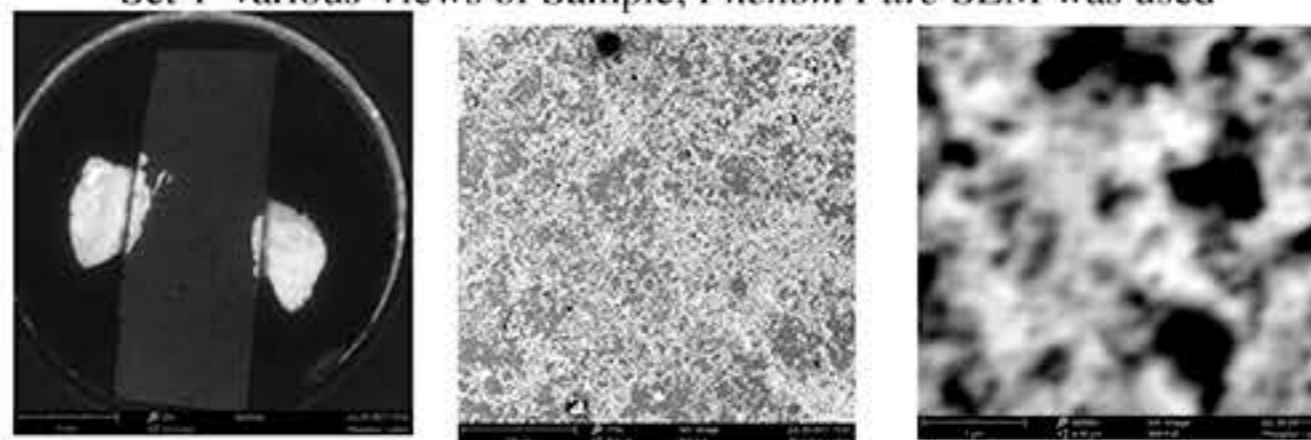


Figure 2-TiO₂

SEM (Scanning Electron Microscope)

- Uses electrons instead of visible light to observe the surface of a sample.
- Set 1 shows a series of images of a composite of MoS₂ and TiO₂ on a silicon substrate.

Set 1-Variety Views of Sample; Phenom Pure SEM was used



The Hall Effect

- Electrons or ions in a sample of material that can move directed under a vertical magnetic field
- Table 1 and 2 show the data collected from the Hall Effect.

Escopia HMS-3000

100nI	sample1	sample2	sample3	sample4
0	7.93E-03	7.94E-03	5.33E-05	2.30E-04
150	2.09E-04	6.03E-03	2.15E-04	1.09E-04
200	2.09E-04	9.07E-03	2.93E-04	6.22E-03
250	2.24E-06	5.71E-04	7.44E-04	9.35E-04

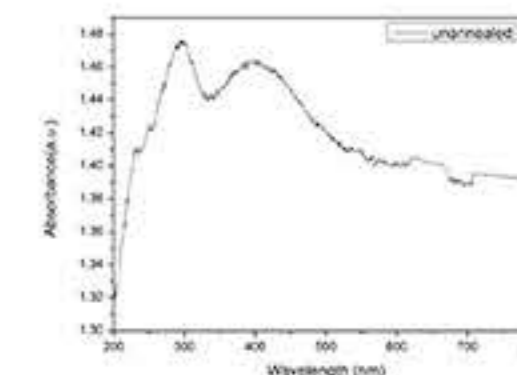
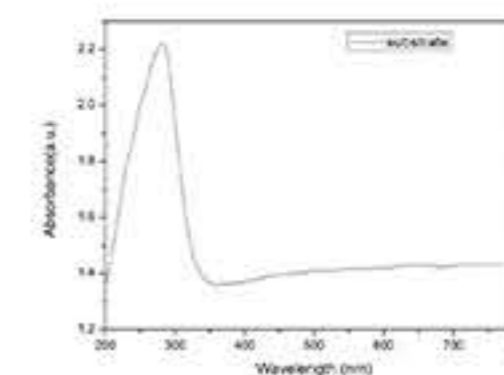
Table 1-Resitivity

100nI	sample1	sample2	sample3	sample4
0	8.26E+00	4.95E+00	7.11E+01	5.84E+00
150	2.72E+01	4.89E+00	5.07E+00	8.03E+02
200	3.56E+01	5.29E-01	9.02E+00	2.17E+03
250	5.49E+01	5.02E-01	1.01E+01	2.09E+01

Table 2- Mobility

UV-Vis System

- Used to see absorbance of light by sample.
- The figures below show the absorbance of an annealed and unannealed sample, respectively.



- The properties demonstrated show promising semi-conductive characteristics for this composite.
- Further testing is required to form a complete conclusion.

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