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GROWTH OF MOLYBDENUM SULFIDE THIN FILM USING VAPOR DEPOSITION

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Abstract:

Ultra thin layers of material deposited on another material are of immense importance for the present day science and technology. In the present study molybdenum sulfide (MoS2), an inexpensive semiconductor material with electronic and optical properties is used. By heating sulfur and molybdenum chloride powders gradually up to the temperature to 800 0C, which vaporizes the powder. The two substances react at high temperatures to form MoS2. The vapor is then deposited in a thin layer onto the glass substrate. The thickness of the MoS2 layer by controlling the pressure and vapor pressure in the furnace.

Key words: *Thin film, vapor deposition, self-limiting growth.*

1.0) Introduction

Involvement with thin films dates to the metal ages of antiquity. Many magnificent examples of statuary, royal crowns, coffin cases that have survive intact attest to the level of skill achieved. It is no wonder that when British gold beaters were called upon to provide the first metal specimens to be observed in the transmission electron microscope.[1]Thin film micro electronics and optoelectronics are among the strongest technological drivers of our economy, a fact manifested by the explosive growth in communications and information processing, storage and display applications[2].

Technologies have fertilized expanding thin film uses in diverse areas e.g.:- coating of all kinds, bio-technology and the generation and conservation of energy. Thin film applications are issues rooted in material science and engineering[2,3].

1.1) **Different techniques**:

There are different methods involved in the preparation of thin films. They are mainly divided as

1. Chemical methods.
2. Physical methods

1.1.1) Chemical methods :

Among the different chemical methods some of the important methods are Anodisation Chemical bath deposition Chemical vapor deposition Electro deposition Electrophoresis Ion-beam sputtering Screen printing Spray pyrolysis[1,3]

1.1.2) Physical methods may be classified as

Epitaxial deposition Ion assisted deposition Ion plating Pulsated laser deposition sputtering techniques Vacuum evaporation Electron beam evaporator[4]

1.2) Experimental:

We are applying a new technique for developing molybdenum sulfide (MoS_2) thin film using the vapor deposition method[5]. The evaporation of a material requires that it be heated to a sufficiently high temperature to produce the desired vapor pressure. The vapor atoms are scattered by collisions with residual gas atoms in the vacuum system[6]. Vaporization of alloys and compounds is usually accompanied by dissociation or association or both process. If the volatilities of the various constituents are significantly different from one another, thermal evaporation takes place. If the constituents are equally volatile congruent evaporation occurs[7]. Heat sulfur and molybdenum chloride powders gradually up to the temperature to 800 ^{0}C, which vaporizes the powder. The two substances react at

high temperatures to form MoS_2. The vapor is then deposited in a thin layer onto the glass substrate[8].

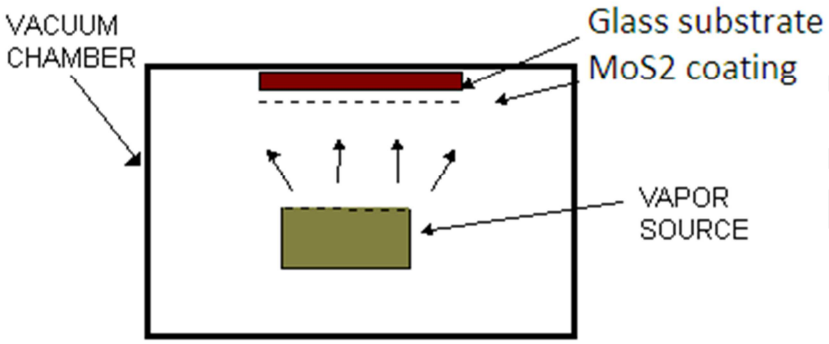

Figure 1.0: Schematic diagram for Vapor deposition

Besides a vapor source, one requires shutters, substrate heaters, a planetary system and monitors and controllers for deposition rate and film thickness. The deposition rate is commonly monitored and controlled with the help of a quartz crystal oscillator, ion current in a nude ionization gauge and an appropriate mass spectrometer[9].

For creating a layer of molybdenum sulfide (MoS_2) on the glass substrate, the pressure must be higher than that of vapor pressure. The higher the pressure, the more layers of MoS_2 will settle down to the bottom[10]. If the pressure is higher than the vapor pressure of a layer of atoms on the glass substrate, but not higher than the vapor pressure of two layers, the balance between the pressure and the vapor pressure can ensure that thin-film

growth automatically stops once the monolayer is formed. It is called self-limiting growth[11].

1.3) Conclusion:

The pressure is controlled by adjusting the amount of molybdenum sulfide in the furnace .If there is more molybdenum in the furnace, the pressure will be higher..Using this technique, we can create wafer-scale molybdenum sulfide MoS_2 single atom layer thin films, one atom thick, every time, We can also create the layers that are two to four atoms thick.

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