ORGANO METALLICS PROJECT

Semiconductor industry has grown so large that, many applications using semiconductors made from many elements have been developed. Compound semiconductors in particular have found many applications.

Compound semiconductors are made by combinations of elements from Groups III / V and II / VI, and contain two or more of the elements. Materials such as gallium arsenide (GaAs), aluminium gallium arsenide (AlGaAs), gallium nitride (GaN), indium phosphide (InP) and zinc selenide (ZnSe) have a wide variety of applications in satellite TV receivers, optical fibre communicationsystems, compact disc players, bar-code readers, microwave generators and LEDs.

Groups III / V semiconductor compounds

Semiconductor compound	Reactants used
Ga As	Me3 Ga, AsH3
Al Ga As	Me3 Al, Me3 Ga, AsH3
In Ga As	Me3 In, Me3 Ga, AsH3

Group II—VI semiconductor compounds

Semiconductor compound	Reactants used
Zn Se	Me2 Zn, H2Se
Cd Te	Me2 Cd, Pr2Te

Development of metal organic precursors made significant contribution to the field of semiconductor growth. These chemicals specifically designed for the MOVPE or CBE process, have improved gas-phase and surface decomposition, leading to very thin high quality semiconductor films.

Metalorganic vapour phase epitaxy (MOVPE): deposition from vaporised orano metal precursors on an appropriate substrate (light used to dissociate the metals)

Chemical beam epitaxy (CBE): deposition by pyrolysis of organo metal precursors on an appropriate substrate.

Atomic layer deposition (ALD): ALD is similar in chemistry to MOVPE, except that the ALD reaction breaks the reaction into two half reactions keeping the precursor materials separate during the reaction.

Market

One major application that can propel the volume of compound semiconductor materials is thin film photovoltaic application. The materials in demand in this area are Cd Te and Cu In Se and Cu In Ga Se.

The compound semiconductors market includes wireless electronic devices, optical data storage, Fiber optics communication, illumination, solar cells, new markets, and other compound semiconductors. Wireless electronic devices have the largest market share, generating revenues of $5.7 billion in 2007. This is expected to increase at a CAGR of 10.8% to reach $9.6 billion in 2012.

Other compound semiconductors have the second largest share of the market with $4.6 billion in revenues in 2007 and an expected $6.4 billion in 2012, representing a CAGR of 6.7%.

The illumination segment generated revenues of just under $2.0 billion in 2007, expected to increase to $2.3 billion in 2012, for a CAGR of 4.2%.

Optical data storage and fiber optics communication both had sales exceeding $1.0 billion in 2007 with expectations for high growth in the next five years. Optical data storage is expected to grow at a CAGR of 15.8% to reach $3.4 billion in 2012, while fiber optics communication should grow at a CAGR of 39.5% to reach $6.1 billion in revenues in 2012

Proposal

Semiconductor fabrication has not taken off in India so far. We cannot ignore this sector. One step in moving ahead in this line is to develop capabilities to produce the high purity (five nines to eleven nines) metal organic precursors. There is good scope for export of products like tri methyl gallium.

We have the capabilities of setting up the project and manufacture.

Product mix

A combined capacity of 30 Tons per year with three modules is suggested

Some of the products

a) Tri methyl aluminum
b) Tri methyl gallium
c) Tetra methyl Germanium
d) Dimethyl / Diethyl Selenide
e) Titanium methoxide
f) Titanium Isopropoxide
g) Acetyl acetonate of Indium, copper, cadmium, Zinc

Manufacturing process

The process starts with reacting the purified metal (not necessarily ultra pure) with suitable organic reagent. The organo metal compound thus prepared may have impurities in the form of organo metallics of the metals present as impurities in the metal. A suitable Lewis base is added to the reaction mixture to prepare an adduct of the target organo metal compound. The mixuture is then vacuum distilled. The adduct is non-volatile, the other organo metallics (impurities) and organic materials are volatile. The volatiles are removed. The adduct is then dissociated. The organo metal compound thus liberated is distilled out under vacuum leaving behind other impurities.

The manufacturing process is not very complicated. The production has to be carried out in clean rooms with all precautions to avoid contamination. The equipment and materials used have to be selected to ensure that they do not contribute impurities.

Technology

The underlying technology is simple. CSIR laboratories will be able to provide support.

Raw materials: Group II, III, V, VI metals and solvents

Utilities

Power, fuel and water needs are moderate

Plant and Machinery

Non reactive glass/ glass lined/ special alloy processing equipment, high vacuum systems and utilities equipment

Estimate of Capital investment

Rs 25 crores to 30 crores

Turnover and profitability

Rs.150 crores with 10 % profit after tax is possible

Suggested location

Chemical processing zone, Vizag

Strategy/ options

This can be taken up as a start up by existing chemical manufacturers. Production of other high purity materials can also be considered. (See apitco`s profile on electronic grade chemicals)

Consultancy from APITCO : Sourcing technology. Selection of plant and machinery. Market study. Detailed project report preparation.