

Hydrogen – Initiated Synthesis of $A^{IV}B^{VI}$ compounds in presence of Aluminum Hydride

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Research Description

- **To develop technology of using substandard component of solid rocket fuel (aluminum hydride) in realization of chemical reactions for synthesis of films and powders of semi-conductor, dielectric and magnetic materials**
- **During long-lasting storage of aluminum hydride, the undesirable spontaneous processes of its decomposition with extraction of gaseous hydrogen occur. In this case the composition of aluminum hydride enriches with metallic aluminum. As a result it facilitate formation of aluminum hydride wastes as substandard component of solid rocket fuel.**
- **In bombing substandard aluminum hydride with chemically active particles (hydrogen atoms), heat current and recombination energy of chemically active particles on the surface of aluminum hydride promote gradual decomposition of hydride phase of aluminum.**
- **The formed active atomic hydrogen may be used for reactions between components of mechanical mixture. the project is aimed on creation of conditions for reorientation of scientists, which are involved in the development of materials for products of war purpose and their involvement in solution of problems, connected with development of technology of using substandard component of solid rocket fuel.**

Main milestones

- **Development of plasmochemical device and optimized generation system for chemically active particles**
- **Regulation of decomposition kinetics of substandard aluminum hydride and chemical reactions for synthesis of materials**

Main milestones

- **Modeling of distribution and determination of quantity of energy of chemically active particles for organization of aluminum hydride' decomposition with moderate speed**
- **Development of unmanned system for shifting of container with mechanical mixture of initial components and aluminum hydride about generation center of chemically active particles**

Main milestones

- **Investigation of the structure, physico-chemical properties of the products of reaction of chemically active particles with initial mixture in the presence of aluminum hydride**
- **Determination of optimal ratio of mechanical mixture and aluminum hydride**
- **Development of the technology for effective use of substandard aluminum hydride in the processes of synthesis of materials**

Research Objectives

- **Experimental and theoretical investigations of the generation mechanisms of chemically active particles in the current of high frequency plasma and their use in controlled decomposition of substandard aluminum hydride are needed for optimization of conditions for obtaining the target products**
- **It is expected the modeling of distribution of chemically active particles along plasma reactor, determination of quantity ratio of aluminum hydride and solid components of mechanical mixture for formation of semi-conductor, dielectric materials with given physical and chemical properties**
- **As a result of optimization of exploitation properties of plasmochemical system it is expected the development of synthesis technology for semiconductor, dielectric, and magnetic materials. The technology will be based on the reaction of solid initial components with active participation of chemically active particles and aluminum hydride.**

Technical Problems and Solutions

- **By mechanically mixing two or more components with aluminum hydride, a nearly equal distribution of aluminum hydride is achieved in the whole volume of mechanical mixture**
- **During bombing of mechanical mixture with chemically active particles, resulting heat and recombination energy causes gradual decomposition of aluminum hydride, thus generating hydrogen atoms**
- **On the other hand, presence of aluminum hydride prevents the process of expansion of metallic crystallites on size, for example, in the processes of obtaining particles of magnetic metals, creating by this favorable conditions for forming particles of determined size.**

Technical Problems and Solutions

- **Potential solutions to current problems are directed at expansion of the assortment of semiconductor, dielectric, and magnetic materials with wide spectrum of controlled physical and chemical properties**
- **Solutions would have the potential to considerably contribute to the electronic industry, the present stage of which is characterized, in particular, by searching non-traditional and high-performance methods**

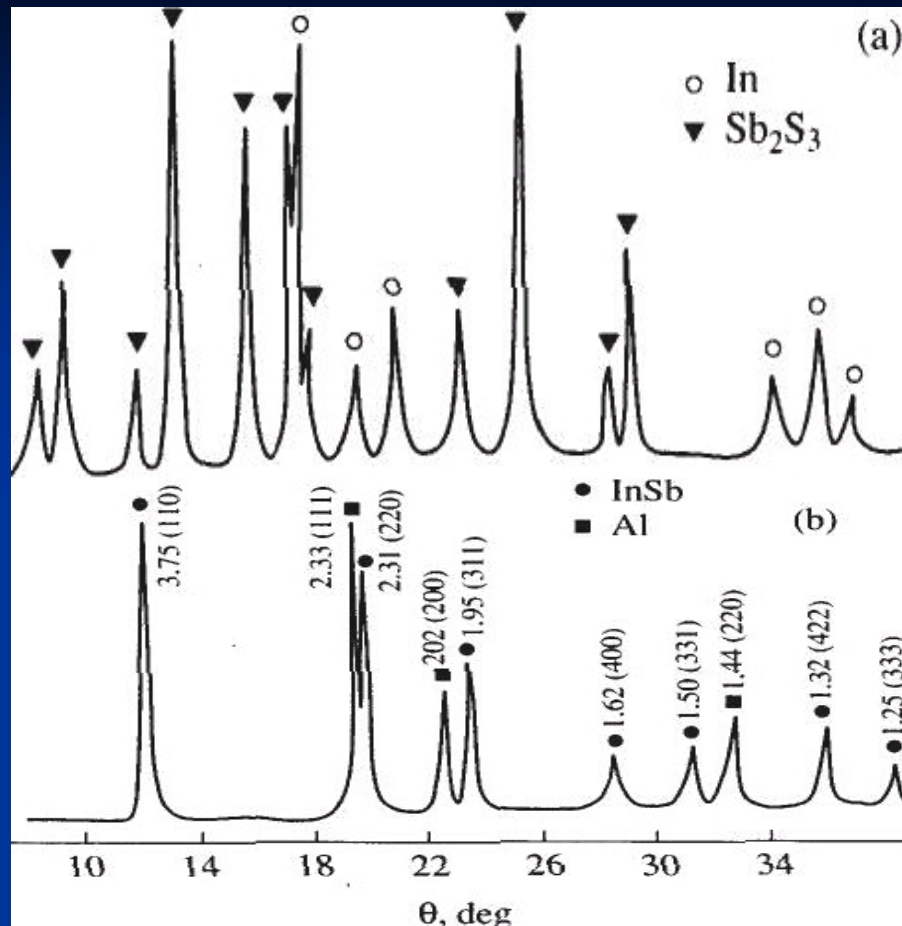


Fig 1. XRD patterns of (a) a mixture of Sb_2S_3 and with aluminum hydride additions and (b) reaction products after hydrogen bombardment for 240 min

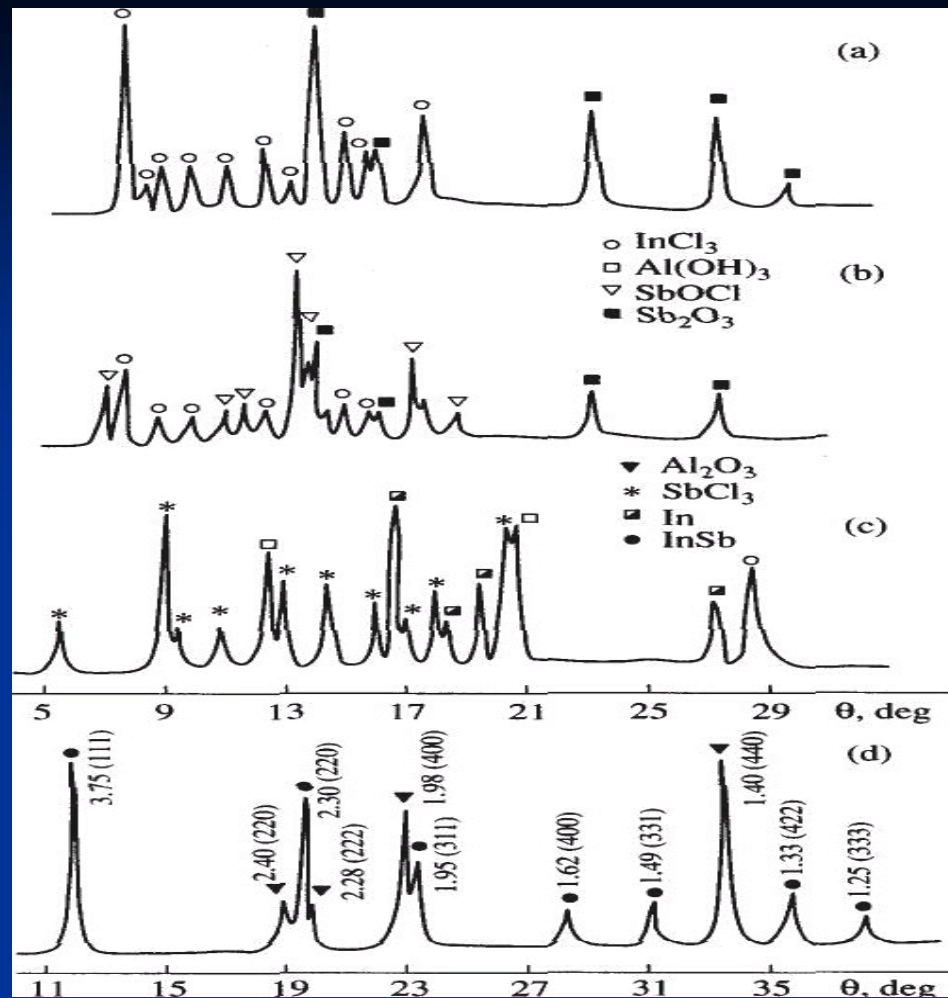


Fig. 2. XRD patterns of (a) an $\text{Sb}_2\text{O}_3 + 1\text{nCl}_3 + \text{Al}(\text{OH})_3$ mixture and (b-d) reaction products after hydrogen bom-bardment for (b) 80, (c) 200, and (d) 300 min

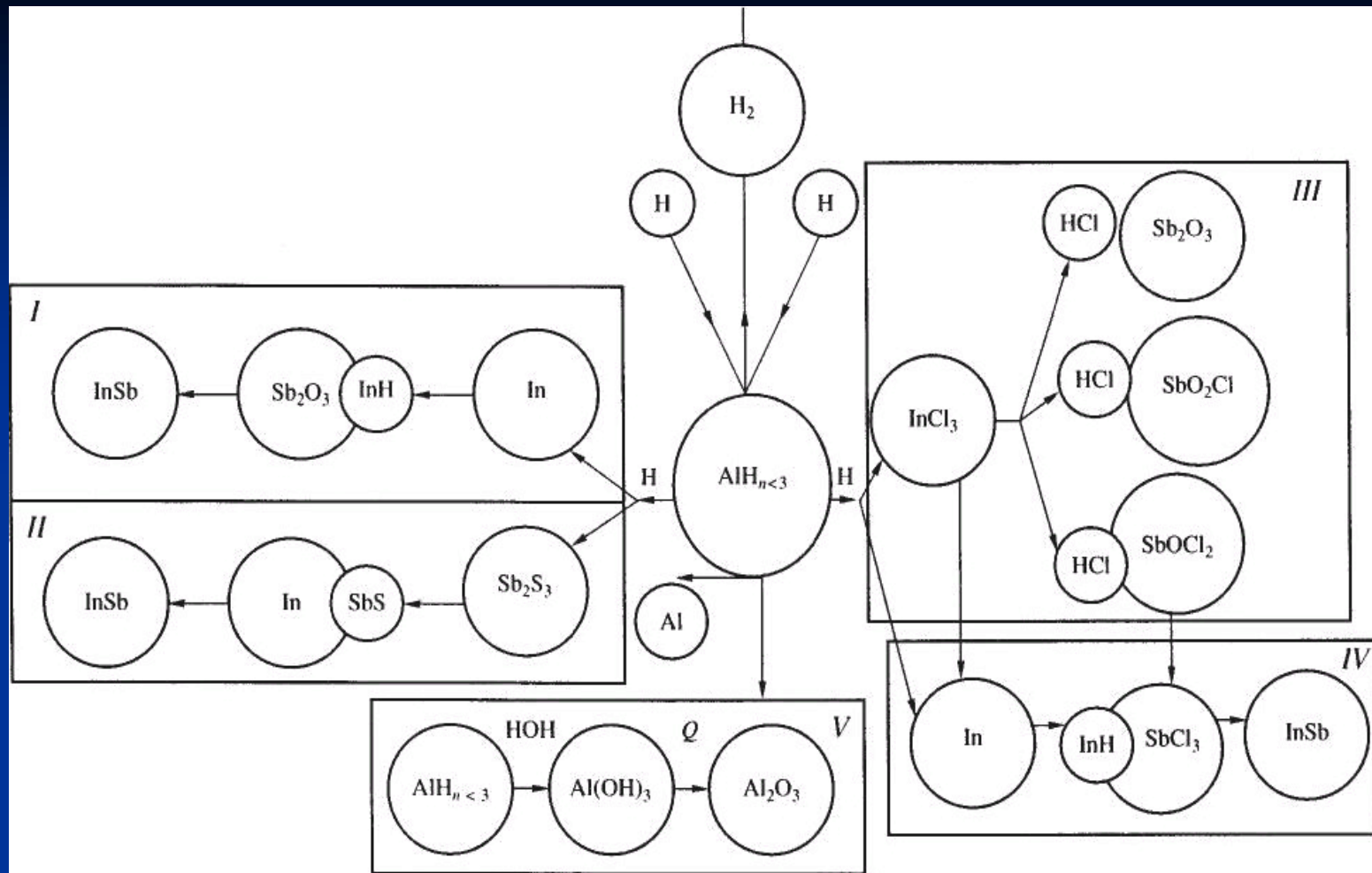


Fig. 3. Reaction schemes of InSb formation from $Sb_2S_3 + In$ and $Sb_2O_3 + InCl_3$ mixtures with aluminum hydride additions under hydrogen bombardment

Applications

- **Microelectronics**
- **Powder technology**
- **Nanomaterials technology**
- **Hydrogen Energy application**

Advantages:

- **Proposed research belongs to the category of fundamental and applied investigations in the field of physics and chemistry of solids, technology of energy-consuming substances, solid microelectronics, and ecology**
- **Applied aspects, which belong to the problem of using substandard component of solid rocket fuel in realization of chemical reactions (which do not run in thermodynamically equilibrium conditions) have importance for expansion of the class of inorganic materials for microelectronics and ecology**
- **This importance is connected with wide use of industrial wastes in manufacture of target products**

Contact Information

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