ADVANCES IN INORGANIC FIBER DEVELOPMENTS

Ashok K. Dhingra
I.E. Du Pont De Nemours & Co. Inc.
Pioneering Research Laboratory
Textile Fibers Department
Experimental Station
Wilmington, Delaware 19898

SYNOPSIS

Inorganic fiber based materials offer potential for the development of next generation advanced materials beyond fiber reinforced plastics. Inorganic fiber needs and technology are briefly reviewed. The difference in structure and properties of alumina and alumina/silica fibers are discussed. The addition of silica to alumina increases the tensile strength but significantly lowers the modulus of the 100% alumina fibers. Next generation advanced aluminum alloys based on reactive Al-Li compositions are shown to be compatible with dense microstructure and relatively stable 100% alumina fibers to yield wellbonded alumina fiber reinforced aluminum matrix composites having predicted mechanical properties. Examples of potential applications for inorganic fibers materials in aerospace and automotive are shown. An important milestone in inorganic fibers technology was recently reached with the introduction of the world's first inorganic fiber reinforced metal matrix composite as a piston insert for an automotive diesel engine.

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INTRODUCTION

I would like to give an overview of inorganic fibers technology, then discuss the developments and keys structural features of alumina and alumina/silica fibers and new products based on inorganic fibers. The development of inorganic fiber reinforced materials requires a systems approach to tailor the fiber structure to be compatible with the matrix and assure component fabricability and performance.

(1) NEED SUITABLE HIGH PERFORMANCE REINFORCING INORGANIC FIBERS FOR
   - METALS
   - CERAMICS
   - THERMAL AND MECHANICAL COMPATIBILITY WITH THE SYSTEM

(2) CATALYST SUPPORTS FOR EMISSION CONTROL SYSTEMS
   - HONEYCOMB/EXTRUDED STRUCTURES
   - FIBROUS SUPPORT STRUCTURES OFFER VERY LARGE SURFACE AREA

(3) DESALINATION AND FILTRATION DEVICES
   - HOLLOW INORGANIC FIBERS
   - CORROSION RESISTANCE IN SEA WATER
   - CONTROLLED POROSITY/MICROSTRUCTURE

(4) BATTERY AND FUEL CELLS

(5) ELECTRONIC APPLICATIONS
   - LOW CONDUCTIVITY, HIGH PERFORMANCE CIRCUIT BOARDS

WHY INORGANIC FIBERS?

Figure 1.

NEED FOR INORGANIC FIBERS

Before discussing "Advances in Inorganic Fiber Developments" let us examine "why the world needs inorganic fibers" (Figure 1).