Sol gel process for making ceramic fibres*

Ceramic fibres are flexible and lightweight. Being refractory, they are used as insulating materials in high temperature furnaces and they save enormous amounts of energy. They have found considerable applications in domestic heating appliances also. Being very strong and also lightweight, they are slowly revolutionizing aerospace industry. The conventional practice of making ceramic fibres is to extrude ceramics melted at very high temperatures through a set of fine holes approximately 3 μm in diameter. In this process a strict control of the diameter has not been possible. Unfortunately, ceramic fibres less than 1 μm diameter are considered very carcinogenic and those finer than 3 μm diameter can get ingested into the lungs during the manufacturing process and can cause serious respiratory diseases. They can also cause severe skin irritation. As a fair proportion of the fibres manufactured by the conventional process contain these small diameter fibres, they can be dangerous health hazards to those involved in manufacturing and handling them. In both UK and USA, a legislation is being introduced to phase out these small diameter fibres.

Recently, a team from Warwick University led by Robert Pullar, with Ashok Bhattacharya as a member in it, has developed a 'sol gel blow spinning technique' which produces fibres of very even diameters. The process uses a sol – a microsuspension of material particles which consolidate to form the ceramics when finally heated to moderately high temperatures (much lower than the melting point). The sol gel can have a simple composition containing iron and aluminium or can be very complex containing 5 or 6 elements, when one wants to make ceramic fibres for piezoelectric and magnetic applications. In the Warwick process, the sols are made more concentrated and viscous by the addition of a small amount of organic polymer which will help the sol to form fibres. This sol is blown by air through a small hole (3 μm diameter) which turns into the gel fibre. This gel fibre is then raised to moderately high temperatures to form the required ceramics. The Warwick group claims that fibres manufactured by this sol gel process have properties identical to those made by the conventional melt process.

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