ADVANCED SILICON NITRIDE CERAMICS

Development of Syalons

Silicon nitride (Si_3N_4) was discovered in the mid-nineteenth century and caused no excitement among the engineering fraternity of the day. The problem was that Si_3N_4 does not lend itself to ease of fabrication.

Over the next century two principle routes for fabricating Si_3N_4 were developed: **hot pressing** and **reaction bonding**.

Hot pressed Si_3N_4 (HPSN), was made by adding a flux (usually magnesia, MgO) to a fine Si_3N_4 powder and then pressing the powder in a graphite die at high pressure and temperature. The resultant HPSN body, although fully dense and extremely strong, could only be made in to simple shapes which would then require expensive diamond grinding to obtain the desired profile.

Reaction bonded Si_3N_4 (RBSN), was made by carefully nitriding silicon (Si) 'dough' to produce a formed piece of Si_3N_4. The RBSN body was porous and low strength, but it was refractory and could be formed in to relatively complex shapes.

Both these materials therefore had significant drawbacks. Then in the early 1970s came a revolutionary breakthrough, which made scientists and engineers alike sit up and take notice. This discovery was made independently at Newcastle University in the UK (*United Kingdom*) by Jack and Wilson (Ian Wilson was our late M.D.) and in Japan by Osana et al. This breakthrough was **the discovery of sialon**, **an alloy of Si_3N_4**. This was the first known man-made ceramic alloy and in 1972, following funding by Lucas Industries, the first Patent was granted for sialon materials under the names of Jack and Wilson.

The term sialon describes **silicon-aluminium-oxynitride alloys of Si_3N_4**. Further work on these alloys soon showed that the days of having to hot press or reaction bond Si_3N_4 to get a useful body, were over. By making additions of rare earth oxides such as yttria (Y_2O_3), fully dense, pressureless sinterable materials could be produced.

Over the next two decades the sialon system was studied meticulously, resulting in the modern day sialons as manufactured by **International Syalons** under the trade name **Syalon**. International Syalons have to date developed 4 grades of sialon, each with their own unique properties. **Syalon 101** is a high strength, tough, hard material, with excellent resistance to corrosion and thermal stability up to 1200°C, which is suited to diverse applications in industries such as molten metal handling, metal forming, oil and gas and chemical and process. **Syalon 050** is a material possessing extreme hardness and thermal stability up to 1400°C, making it particularly suited to wear applications. **Syalon 501** is an electrically conducting grade which allows forming by electro-discharge machining and makes the material suitable for sensor applications. Lastly **Syalon 110** is a grade developed to give improved resistance to corrosion by steel and has been used at temperatures above 1500°C.

Certificate No. 930359

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