



IP OPPORTUNITY

Crystalline Ternary Ceramic Precursors

Invention Description

The invention relates to more effective and economic synthesis of compounds of general formula $M_{n+1}AX_n$, such as Ti_3SiC_2 , which have become known as MAX phases. MAX phases have an unusual combination of the properties of metals (electrical and thermal conductivity, some ductility and excellent thermal shock resistance) with those of ceramics (good high temperature stability, creep resistance and excellent resistance to a wide range of aggressive chemicals).

The materials are known to be difficult to synthesize in phase pure form being prone to contamination by other compounds. Synthesis generally requires solid state sintering at temperatures in the range 1400-1600°C for a number of hours. Even at these high temperatures it is common to find >5% of other compounds present in the material, to the detriment of its properties.

The invention provides a synthesis method that goes directly from a binary pre-cursor compound to the desired MAX phase without the formation of other compounds. It may be conducted at temperatures many hundreds of degrees lower than conventional methods.

Inventors

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Features and Benefits

- Better and more reproducible properties due to low contamination by unwanted compounds
- Lower costs due to:
 - Lower energy costs (typically <1100°C instead of 1400-1600°C)
 - Lower equipment costs (conventional alloy wire wound furnaces and alumino-silicate refractories instead of specialized very high temperature furnaces e.g. $MoSi_2$ elements and high Al_2O_3 refractories)
- Lower environmental impact (lower energy consumption, lower embodied energy in furnace equipment)

Market Value and Size

These are emerging materials and as such, there are currently only relatively few commercial applications.

Potential Application and Market Opportunities

- High power electrical switching equipment
- Electrochemistry cells
- Fuel cells
- High temperature barriers or liners in energy production by conventional (coal or gas fired), renewable (solar concentrator) or nuclear energy production.
- Low adhesion moulds for polymer and elastomer moulding (some covered by US patent)
- High temperature - low friction coatings

Development Stage

Patent filed, seeking commercial partner to develop further.