METHOD FOR PREPARING POROUS MULLITE CERAMIC FROM PICKERING EMULSIONS

IITM Technology Available for Licensing

Problem Statement

- Porous mullite ceramic used in a wide range of applications such as high temperature insulation, filter membrane for highly corrosive and high-pressure environments.
- However, the functional properties desirable for a given application is highly dependent on the composition and microstructure of the porous network, which in turn depends on the processing technique which described **lengthy inefficient processing method** and **inefficient properties** of particles as final ceramic.
- Hence, there is a need of improved method to overcome above issues.

Technology Category/ Market

Chemical Engineering: Porous Mullite Ceramic;
Industry: Manufacturing, Chemical;
Applications: Advanced materials, Medical devices, Equipment to meet stringent;
Market: The global porous ceramic market size was valued at **USD 5.98billion** in 2020, & is expected to expand at a compound annual growth rate **CAGR** of **10.4%** from 2021 to **2028.**

Technology

- Present invention describes **a method for preparing porous mullite ceramic from Pickering emulsions stabilized by hetero-aggregate of oppositely charged fumed oxide particles**.
- The **pore size** of **final ceramic structure** is controlled by tuning the emulsion droplet size wherein the droplet size largely depends on the **mixing fraction of the particles**, **aqueous phase pH** and the **homogenization speed** which eventually **control the pore size** in the final **ceramic**.
- The porous ceramic is prepared by drying and sintering of emulsion get stabilized by oppositely charged particles.
- The **method** comprises steps mentioned inbelow:

1. Using oppositely charged fumed oxide particles to stabilize oil-in-water Pickering emulsions, wherein the volume ratio of oil phase to aqueous phase fixed at 1:1;
2. Using Pickering emulsions template that is formulated with fumed oxide nano particles (silica & alumina) to produce green body which is transformed into solid porous material with a controlled porosity and pore size by sintering
3. Emulsifying the resulting sample consisting of oil and aqueous phases with a homogenizer (IKA T25 ULTRA TURRAX) at 13000rpm for 3 min

Intellectual Property

IITM IDF Ref. 1839;
Patent No. 379956 (Granted)
PCT Application No. PCT/IN2020/050457
US Application No. US 17/595,893

TRL (Technology Readiness Level)

TRL- 3/4, Proof of Concept Ready and Tested and validated;

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Key Features / Value Proposition

❖ ***Technical Perspective:***

1. Current invention facilitates **high stability** of the particle due to their **microstructure**.
2. **Extended control over the mouldability of emulsion** is ensured by its gel-like behavior.

❖ ***Industrial Perspective:***

1. The **Microstructure** of the final ceramic consisting of micron sized pores with **nano-porous struts** adds to the **effective tortuosity**, **porosity** and surface area of the porous mullite material.
2. The process as claimed in the invention is comparatively less time consuming, and energy consumption reduced.

Images

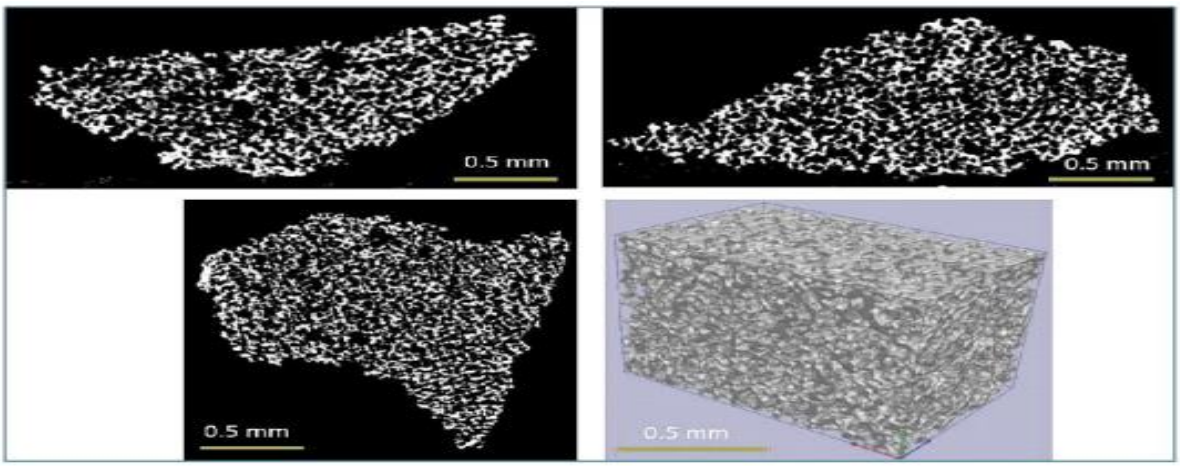

FIG. 1: Illustrates a schematic view of the nano- tomography images of the sintered porous mullite ceramic material obtained from Pickering emulsion

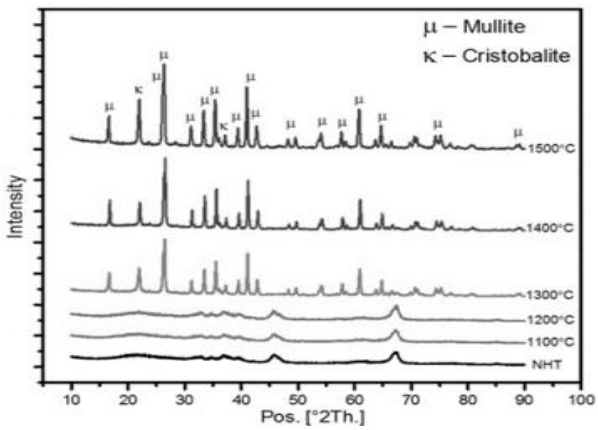

FIG. 2: Illustrates the X-ray diffraction (XRD) spectrum showing development of phases as a function of the sintering temperature

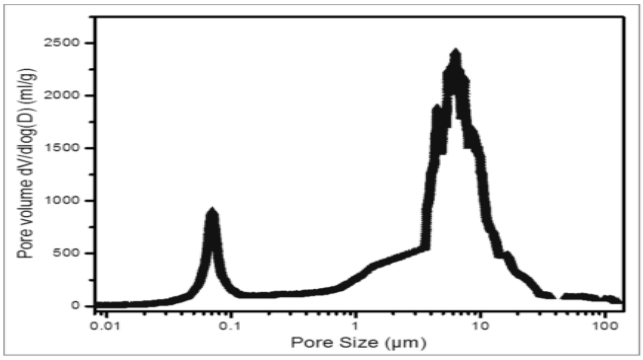

FIG. 3: Illustrates graphical representation of pore size in the porous mullite ceramic

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