Supercritical drying processes to manage the density of lightweight materials

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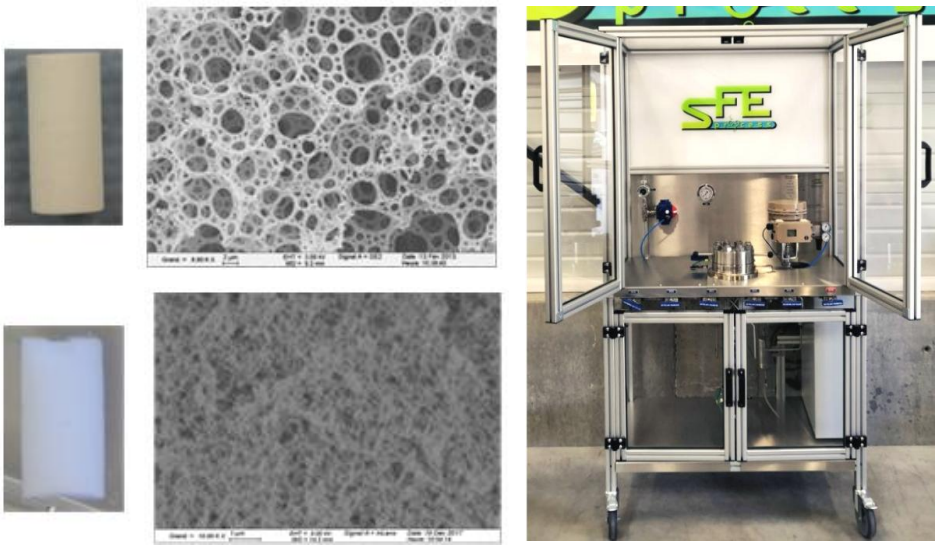
New materials that are stronger and lighter than ever before are constantly developed for a more energy-efficient and eco-friendly future in a broad range of industry sectors, from transportation to medical technology. Mainly of lightweight materials have alveolar structures to ensure high properties such as high energy-absorption capability for vehicles components, high thermal-insulating capability for building components or high specific surface area in catalytic processes. Porous materials are frequently used also as parts of targets for various experiments of plasma physics, where density is one of the key properties of the studied materials. The know-how of CEA/DAM in lightweight materials synthesis and their crucial drying step in supercritical fluids are presented.

Organic micropore foams based on CH_x are synthesized by polyHIPE technique (polymerisable High Internal Phase Emulsion) through several steps in water and organic solvents to get lightweight materials in a wide density range around 150 mg/cm^3. Inorganic nanopore foams based on refractory ceramic oxides are made by sol-gel synthesis from alkoxide precursors in ethanol as solvent. In spite of synthesis parameters tuning to obtain CH_x foams and inorganic aerogels of desired densities, solvents removal by supercritical drying still stands for a critical step, where the alveolar structure can collapse or undergo shrinkage. To manage the final densities of the synthesized materials, autoclaves equipped with regulation systems for controlled pressure and temperature ramps are used and developed to ensure efficient, versatile and reliable drying processes. Advances and outcomes are presented.



Pictures and SEM morphologies of CH_x foam (top left) and SiO_2 aerogel (bottom left) and supercritical ethanol drying equipment.