# Preparation of nanoporous silica aerogels prepared by subcritical drying for Stirling pump and heat insulating composite

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Optimization of thermal insulation is important and necessary task developing heat pumps as machine parts. Moreover, through these parts heat dissipated into surrounding environment, because of heat pump high thermal conductivity and heat transfer, this way reducing overall device efficiency [1]. A comparison of the insulating properties of the existing high–class insulation materials confirms that aerogel granules possess the best insulation properties at this time in consequence of specific and unique structural features and could be applied for a very effective case insulation for important details in a reverse Stirling engine.

The high price of aerogel granules is restricting wide use of aerogels. However, in the scope of EFFiHEAT project a method for obtaining an aerogel material with similar thermal properties (specific heat, thermal conductivity, and density) by subcritical drying to those of CABOT aerogel granules has been developed. During the first stage of the project EFFiHEAT a reproducible preparation scheme for production of millimeter scaled superhydrophobic nanoporous silica aerogel granules was investigated based on the procedure described in [2, 3]. Aerogel preparation method is based on synthesis of silica xerogels after solvent exchange in ethanol at 40 $^{o}$C and surface hydrophobisation with trimethylchlorosilane at room temperature. pH and temperature measurements has been used to describe quantitatively the process of solvent exchange during time.

The thermal properties of as prepared aerogel granules at room temperature are: specific heat Cp = 1420 J/kg×K, thermal conductivity $\lambda = 0.033$ W/m×K and bulk density about 0.1 g/cm$^3$, and nanoporosity more than 95 %.

Within NANOPLASTAS project production of superhydrophobic nanoporous silica aerogel granules prepared by subcritical drying based on aerogel preparation method described in [3] with basic widely available EPS polystyrene beads for heat insulating materials was investigated [4]. The unique properties of silica aerogels and polystyrene composite allow for extensive use of this material comparing to classic heat insulation materials.

References

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4. Project "Development of the new generation porous insulating plastic mass by applying functional nanomaterials (NANOPLASTAS)" [http://tech.met.lt/en/project/nanoplastas].