Ceramics International, vol.49, no.6, pp.9725-9734, March, 2023.

Portland cement clinkers turned into garnets by spark plasma sintering

J. Sánchez Del Río Sáez; A. Páez Pavón; J.M. Torralba Castelló; D. Garbiec; J.S. Moya Corral; S. López Esteban; C. Pecharromán García

Abstract-

The feasibility of sintering Portland cement clinker powders by Spark Plasma Sintering (SPS) has been studied. Different SPSed compacts have been successfully obtained by this technique. The compacts have been characterized by means of X-Ray Diffraction, InfraRed spectroscopy, Scanning Electron Microscopy, Raman Microscopy and Vickers hardness. It is worth noting the finding that slight mineralogical variations in the starting compositions may induce dramatic changes, both in the final mineralogical composition and in the morphology, which can affect the properties of the SPSed compacts. Thus, we find that SPS allows artificial garnets to be obtained in the laboratory by applying pressures as low as 50 MPa, while they are materials that would require much higher pressures in natural environments (2–10 GPa). According to the Selsing model, it has been calculated that the material itself acts as a pressure amplifier at the micrometric level by a factor of 40–200 times. A new model describing the formation of garnets considering the emergence of two transitory eutectic liquids has been explained to justify this phenomenon. This result opens the door to looking for compositions for specific applications with high added value in the field (i.e. high hardness), mainly in the manufacturing of high-pressure (GPa) phases by applying relatively low pressures (MPa).

Index Terms- Portland cement clinker; Garnet; Spark plasma sintering (SPS); Microstructure

Citation:
Sánchez Del Río Sáez, J.; Páez-Pavón, A.; Torralba, J.M.; Garbiec, D.; Moya, J.S.; López-Esteban, S.; Pecharromán, C. "Portland cement clinkers turned into garnets by

spark plasma sintering", Ceramics International, vol.49, no.6, pp.9725-9734, March, 2023.