Compositional analysis of NaCl by thermoanalytical, structural, and optical methods for controlled combustion of nanodiamond particles

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Sodium chloride (NaCl) is one of the best known and most studied materials in the history of materials science. It has a wide range of applications from material's research, chemical industry, to common household use or as a material for sprinkling in winter. Interestingly, NaCl was recently also used as a catalyst for nanodiamond (ND) purification, rounding, and shape modifications; however, the origin of such an effect still remains unclear. This work is motivated to investigate the NaCl behavior deeper and reveal the cause, which could lead to such behavior.

In this work, the NaCl powder samples and a single crystal of NaCl were studied by thermal analyses such as differential scanning calorimetry (DSC) and thermogravimetry (TG), mass spectrometry (MS), optical stereomicroscopy (OM), optical thermomicroscopy (OTM), and powder X-ray diffraction (XRPD). The effect of grain size in NaCl powder samples and the effect of the purity of the materials used on their behavior during thermal treatment were determined. Experiments were carried out on samples with undefined size (raw NaCl), particle sizes of 100 and 200 μm (sieved raw NaCl), different moisture levels, and different purity (NaCl purified by zone refining). The thermomechanical analysis (TMA) showed that reducing the grain size led to earlier grain densification and subsequent sintration as well as the influence of the purity. XRPD analysis was used to determine the structure and phase composition, confirming the presence of only NaCl. On the contrary, the MS proved the presence of a small content of H_2O, which was released at temperatures similar to those at the ND's rounding occurred, indicating a possible contribution of water in the NaCl catalytic action on NDs.

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