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|  |  |  הטכניון - מכון טכנולוגי לישראל TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY  |
| הפקולטה להנדסה כימיתע"ש וולפסון |  |  |
| The Wolfson Department of Chemical Engineering |  |  |

**Wolfson Department of Chemical Engineering Seminar**

**Monday, March 25th, 2024 at 13:30**

**Room 1**

**The Influence of Doping on Conventional and Flash Sintering Using MgO as a Model System**

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**Final PhD Seminar**

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Point defects are playing an important role in mass transfer during sintering of many ceramic systems. Controlled by both mass transfer and electrical behavior, flash sintering evokes a long-standing debate about the main mechanism controlling it. To better understand the flash sintering phenomenon, magnesium oxide (MgO) was chosen as a model system for doping. MgO has a rock salt structure. Due to its dense structure, the main point defects are vacancies. An ion in the MgO lattice can diffuse via a vacancy mechanism in which it jumps into a nearby vacancy site. Cation substitutional doping usually also involves strain due to size mismatch. However, it is possible to somewhat limit that strain by using similar sized dopants. The possible candidates for Mg substitutional doping are Li1+ (acceptor), Sc3+ (donor), and Zn2+ for isovalent doping. The Mg2+ ionic radius is 72 pm in six-fold coordination; Li1+ is 76 pm; Sc3+ is 75 pm; and Zn2+ is 74 pm. Doping with lithium enhances the oxygen vacancies concentration, while doping with scandium enhances the Mg vacancies concentration. Doping with zinc is not likely to create any vacancy defects. In this research, we consider low doping levels, below the solubility limits, to prevent creation of secondary phases.

In the conventional sintering, it was found that oxygen vacancies created by Li doping greatly decrease the sintering temperature of magnesium oxide compared to the metal vacancies’ effect created by Sc doping. Sc and Zn dopants show less profound influence compared to the Li. Enhancing the oxygen vacancies concentration creates an *additional mechanism* for sintering since the anion sublattice is the backbone of the material and oxygen ions diffusion is the rate-limiting step. In flash sintering, Li doping substantially lowers the onset conditions necessary for the flash event compared to Sc- and undoped MgO. Microstructure examination unveils the formation of hotspots and a breakdown channel. The results are analyzed regarding the influence of the resulting native point defects using the doping factor approach.