On Modeling and Simulation of some Heat and Mass Transfer Phase Changes Problems

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In 70s and 80s of the last century Raytcho Lazarov was leading in the Institute of Mathematics, BAS, a group on modeling and simulation of heat and mass transfer processes in the presence of phase change. The specific topic was solidification of metals and alloys, and the research and development was carried out as part of the collaboration between the Institute of Mathematics the Institute of Metal Science of BAS. In the first part of this talk some of the results obtained at that time under the leadership of Raytcho will be recalled.

Currently, convective drying is used by industry in the vast majority of battery electrode manufacturing processes. However, it is characterized by very high energy consumption and there are also limitations on the production speed. There is a demand for more efficient drying processes. Among the several technologies which are studied currently, the most promising and closest to the industrial standards is the near infrared radiation, NIR. There are a great number of experimental and numerical papers on convective drying, but NIR is still not widely studied. In this talk, we present an experimental and numerical study of electrode drying, including those with high-intensity NIR. We report several findings: (i) no vertical temperature gradient is observed in the carried experiments; (ii) NIR enables fast drying with good adhesion; (iii) no capillary limitations are observed in NIR drying of thin electrodes; (iv) presented comparison between the experimental and numerical results, shows that the model used correctly represents the experiment; (v) we elaborate on how NIR is heating the slurry volumetrically, in contrast to the surface heating in the convective drying.