Numerical modeling of parallel-plate based AMR

In this work we present an improved 2-dimensional numerical model of a parallel-plate based AMR. The model includes heat transfer in fluid and magnetocaloric domains respectively. The domains are coupled via inner thermal boundaries. The MCE is modeled either as an instantaneous change between high and low field or as a magnetic field profile including the actual physical movement of the regenerator block in and out of field, i.e. as a source term in the thermal equation for the magnetocaloric material (MCM). The model is further developed to include parasitic thermal losses throughout the bed in the direction not resolved through a realistic description of the thermal resistance between localized points in the bed and the ambient. The results show that the additions to the model place numerical modeling of AMR very close to the corresponding experimental results. Thus, the model is verified by direct comparison with experiment. This is used as a firm basis for predicting and optimizing performance of a large variety of regenerator configurations in order to study and learn the trends, tendencies and even absolute values of temperature span and cooling powers for the optimal (and buildable) designs.