UNIVERSITY OF AMSTERDAM
Institute of Physics

The pressure induced by the growth of salt crystals in confinement

Noushine Shahidzadeh

University of Amsterdam , Institute of Physics, Science Park 904, 1098 XH Amsterdam (The Nederlands)

The precipitation of salt minerals in confinement (e.g. pores in porous media) is known to severely damage buildings, to be responsible for the weathering of rocks and to reduce the permeability in oil reservoirs. In all of these cases, crystal growth occurs within the pore spaces of the material, inducing mechanical stresses on the scale of the individual grains or pores. A condition for damage to occur is that the crystal continues to grow even in confinement, and that the resulting stress damages the rock or stone.

Arguments explaining that growing crystals can exert a pressure have been given for more than 150 years; however the mechanisms are still heavily debated since according to both Riecke's principle and crystal growth theories, a mechanically constrained crystal because of its higher solubility should dissolve rather than exert a pressure. Consequently, for understanding the deterioration mechanism of crystal growth, a direct measurement of the crystallization pressure exerted by growing crystals is needed. This is a challenging problem as illustrated by the small number of experimental results reported in the literature.

We present a novel method that we have developed in order to directly measure the pressure exerted by a growing microcrystal in a confined geometry under controlled environmental conditions. This new method allows us to follow simultaneously the nucleation and spontaneous growth of the crystal from the salt solution and to measure the subsequent pressure developed at the pore scale. The important role played by the wetting properties and the nature of the salt on the development of a pressure during the growth will be discussed.