

In-situ observation of nucleation process in a solution by TEM

YUKI KIMURA¹, KATSUO TSUKAMOTO²
AND JUAN M. GARCÍA-RUIZ³

¹Department of Earth Science, Graduate School of Science,
Tohoku University, Sendai, Japan
(ykimura@m.tohoku.ac.jp)

²ktsuka@m.tohoku.ac.jp

³Laboratorio de Estudios Cristalográficos, Instituto Andaluz de
Ciencias de la Tierra, Consejo Superior de Investigaciones
Científicas–Universidad de Granada, Spain
(jmgruiz@ugr.es)

Nucleation is the process by which the ions or molecules in solution cluster to form crystalline particles with an ordered array. However, the scale at which these clustering occurs is too small to allow a direct in situ observation of the phenomenon. In order to visualize this process at atomic scale we have performed a transmission electron microscope (TEM) study using for the first time ionic liquids as solvent. The choice of ionic liquids avoids evaporation and radiation damage without confinement of the solution in special designed cells, as in previous studies [1-3]. By this novel technology we have recorded live video sequences of the formation and dissolution of clusters of the two known polymorphs of NaClO₃ at a resolution of 0.7 nm using 1,3-diallylimidazolium bromide as solvent [4]. Our results show a fresh and novel view of the phenomenon of dissolution and nucleation at nanoscale, for instance that a) clusters of both, stable and metastable polymorphs do form simultaneously with different nucleation and dissolution kinetics; b) that they form independently of the supersaturation value; c) that dissolution at nanoscale occurs not by a smooth a continuous loss of mass but by fluctuations. These and other new observations will be discusses during the talk.

[1] Yuk, J. M. *et al Science* **336**, 61-64 (2012). [2] Li, D. *et al Science* **336**, 1014-1018 (2012). [3] Liao, H.-G. *et al Science* **336**, 1011-1014 (2012). [4] Kimura, Y. *et al J. Am. Chem. Soc.*, DOI: 10.1021/ja412111f. (2014).