Geophysical Research Abstracts
Vol. 20, EGU2018-11702, 2018
EGU General Assembly 2018

Direct Determination of Surface-Adsorbed Cluster Properties From Heterogeneous Nucleation Measurements

Robert McGraw (1), Paul Winkler (2), and Paul Wagner (3)

(1) Environmental, and Climate Sciences Department, Brookhaven National Laboratory, Upton, NY 11973,United States (rlm@bnl.gov), (2) University of Vienna, Faculty of Physics, Vienna, Austria (paul.winkler@univie.ac.at), (3) University of Vienna, Faculty of Physics, Vienna, Austria (paul.wagner@univie.ac.at)

Re-examination of temperature-dependent heterogeneous nucleation of water vapor on silver nano-particles is shown to provide the energy and entropy of cluster-substrate interactions directly from measurements of nucleation probability. Temperature dependence is correlated with degree of cluster stabilization by the nano-particle seed and previously found cases of unusual increasing nucleation onset saturation ratio with increasing temperature are explained. A necessary condition for the unusual positive temperature dependence is identified, namely that the critical cluster be more stable, on a per molecule basis, than the bulk liquid to exhibit the effect. Temperature dependence is next examined in the classical Fletcher model, modified here to predict cluster energy and entropy. The contact angle used in the Fletcher model is identified as the microscopic contact angle, which can be directly obtained from heterogeneous nucleation experimental data by a recently developed analysis method. Here an equivalent condition, increasing contact angle with temperature, is found necessary for occurrence of unusual temperature dependence. Our findings have immediate applications to atmospheric particle formation and to technologies for nano-particle detection using condensation particle counters (CPCs).
Reference:

R. L. McGraw, P. M. Winkler & P.E. Wagner (2017). Scientific Reports 7, 16896.