PRESENTATION TYPE: Contributed Paper: Poster
CURRENT SUBJECT AREA: Materials & Nanoscience (8)
CURRENT SYMPOSIA: Supramolecular Assemblies at Surfaces: Nanopatterning, Functionality, Reactivity (#346)
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TITLE: Scanning Tunneling Microscopy Investigation on Line Tension Driven Nanoparticle Packing

Abstract Body:
Evaporation driven particle packing has been investigated to reveal interesting patterns at micrometer to millimeter scale, known as the “coffee ring effect”. While the microscopic structures of these patterns are well characterized, the molecular level arrangements of individual molecule or particle in these patterns are less known mainly due to the difficulties in attaining high-resolution images. Additionally, as the line tension at the ring front could impact assembly or packing, the validity of this effect at the nanometer and molecular level still need to be confirmed. This work uses scanning tunneling microscopy (STM) for the investigation of the packing of G4-polyamidoamine (PAMAM) dendrimers on gold substrates at the meso and nanometer scale, upon solvent evaporation. Dendrimers were pre-coordinated with Pt²⁺ ions to increase conductivity to enable STM imaging. Novel patterns are revealed at the nano- to mesoscopic level: e.g. near periodic line arrays with voids decorating the lines and polymorphic line gratings, as shown in Figure 1. The monolayer deep voids ranges from 54.9 to 79.1 nm in diameter. The spacing of the lines measures from 2.9 to 8.0 nm. The geometry and local order depend on the functionality of the dendrimer termini and substrate surface, as well as the solvent and its evaporation. This work demonstrates that “coffee ring effect” extend to the nanometer level, and that STM provides the means for investigation the nano and mesoscopic nanomaterial assembly by line tension.

Figure 1. High-resolution STM image reveals the packing of individual G4-PAMAM-NH₂ dendrimer on gold substrate.