Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Using in-fiber fluid instabilities for the scalable production of structured spherical particles AYMAN ABOURADDY, JOSHUA KAUFMAN, GUANGMING TAO, SOROUSH SHABAHANG, ESMAEIL-HOOMAN BANAEI, University of Central Florida, DAOSHENG DENG, XIANGDONG LIANG, STEVEN JOHNSON, YOEL FINK, Massachusetts Institute of Technology — Developing efficient pathways to the fabrication of spherical particles is needed for a wide range of applications ranging from drug delivery to cosmetics. A heretofore unanswered technological challenge is the development of a single process for fabricating particles over a wide range of sizes, from a variety of materials, and in different structures. Here we harness the high-volume process of fiber drawing to create a scalable nanomanufacturing approach to address this challenge. We make use of a new class of multi-material fibers drawn from a macroscopic "preform" combined with the recent observation of an in-fiber Plateau-Rayleigh capillary instability (PRI). A macroscopic cylindrical preform is drawn into an extended fiber and subsequent thermal treatment induces the PRI at the heterogeneous interfaces along the fiber, causing the core to break up into a necklace of uniformly sized spheres held stationary in isolation in a cladding matrix. This process enables the fabrication of structured spherical particles from a variety of materials spanning an unprecedented range of sizes: from 2 mm down to 20 nm. By structuring the core at the preform stage, we produce multi-material core-shell particles, "Janus" particles, and multi-sectioned "beach ball" particles. By combining multiple cores in the same fiber we demonstrate an exceptionally high level of parallelization, rendering the process scalable.

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Date submitted: 09 Aug 2012 Electronic form version 1.4