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Atmospheric Pressure RF Discharge for Nanocrystal Synthesis[1]

NARULA BILIK, BENJAMIN GREENBERG, UWE KORTSHAGEN, Univ of Minn - Minneapolis — Atmospheric pressure plasmas are inexpensive alternatives to low-pressure plasmas. Constructing such plasmas is a challenge due to the instabilities associated with high pressure. Most RF atmospheric pressure plasmas are microplasmas built to preserve the Paschen's law scaling, leading to small volumes and low production quantity. Here we present a large-volume (non-micro scale) atmospheric pressure plasma for nanocrystal synthesis. The plasma is a dielectric barrier discharge with an average gap spacing of 2.4 mm. The discharge appears uniform viewed by the eye. The gap spacing is non-uniform: discharge is first initiated in a region where the gap spacing is minimum to encourage the formation of free electrons and metastables, then the discharge expands to fill the entire volume as the voltage is increased; this way, the discharge remains uniform over large volume. Zinc oxide nanocrystals with a crystallite size of about 12 nm were produced in the reactor. The shape of the nanoparticles sensitively depends on the residence time. Near-circular particles were produced when using a carrier flow rate of 5 slm, while elongated particles were produced when using a carrier flow rate of 10 slm.

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