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Silicon nanocrystal synthesis in microplasma reactor TOMOHIRO NOZAKI, Tokyo Institute of Technology, TOMOHISA OGINO, TAKASHI NAKAMUTA, KENJI SASAKI, KEN OKAZAKI — Atmospheric-pressure microplasma reactor was developed for the fabrication of tunable photoluminescent silicon nanocrystals. A mixture of Ar, H2, and SiCl4 was activated by capacitively-coupled non-equilibrium plasma generated in a capillary glass with a volume less than 1 μl. The microplasma efficiently realizes supersaturated silicon vapor that leads to gas phase crystal nucleation via three-body collision, followed by rapid termination of crystal growth due to short-residence-time reactor. The room temperature photoluminescence (PL) of as-synthesized material with H2 = 0.7% exhibited intense visible light emission with peak intensity around 670 nm. The TEM analysis of the red-luminescent material revealed crystalline particles with sizes around 3 nm and amorphous silicon oxide shell which surrounds the crystalline core. The PL spectrum was blue-shifted to 520 nm with increasing H2 content. The green-luminescent materials were readily oxidized upon exposure to air, and the PL capability attributing to silicon nanocrystal was extinguished within a few hours. The PL spectrum was well stabilized by adding a trace amount of CH4. The surface structure of silicon nanocrystals might be modified by inserting hydrocarbon capping.

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