Site-selective Formation of Nanocrystals using the Nanoscale-electrocrystallization and Fabrication of Nanocrystal Based Devices

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We have developed the "Nanoscale-electrocrystallization" for nanodevice fabrication [1]. The Nanoscale-electrocrystallization enables to bridge a nano- or microgap between two electrodes with nanocrystal using alternating current (ac). Unlike the bulk electrocrystallization, two electrodes used for electrolysis are formed on a glass or a silicon substrate with oxide layer for device fabrication. A one-component electrochemical cell was used. The Nanoscale-electrocrystallization enables to develop widely many organic conductors which can obtain from the bulk electrocrystallization.

The Nanoscale-electrocrystallization gave two kinds of nanocrystals with different electronic state according to the starting material. One is partially-oxidized, the other is completely one-electron oxidized. To obtain partially-oxidized nanocrystals, dicyanocobaltphthalocyanine tetraphenylphosphonium salt was used for a starting material. Needle nanocrystals ranging from 14 to several handred nm in width were selectively formed in a gap between two electrodes by the ac electrolysis [2]. On the other hand, we also obtained the completely one-electron oxidized nanocrystal which is known as Mott insulator in bulk synthetic metals. Dicyanocobaltphthalocyanine potassium salt was electrolyzed in methanol. Obtained nanocrystals ranging from 100nm to several hundred nm in width and 1μm to several ten μm in length were also selectively formed at the gap between two electrodes when ac was used.

We also obtained bottom-gate type field effect transistor (FET) structure when highly-doped silicon substrates with SiO_2 layer were used as electrode substrates. Two electrodes for electrolysis can be utilized as source and drain electrodes. We performed i-V measurements at various gate voltages.

The details of nanowire fabrication and physical properties will be reported.

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