

ビスマスサブナノ粒子の精密合成と合金化

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Precise controlled synthesis and alloying of bismuth sub-nano sized particles

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It has been reported that sub-nano sized particles with a diameter of about 1 nm exhibit properties different from those of bulk or nanoparticles. This is attributed to the fact that sub-nano sized particles had a special electronic state. In our previous works, we have achieved a precisely controlled metal assembly and synthesis of sub-nano sized particles using phenylazomethine dendrimers (Fig. 1). For example, we succeeded in synthesizing Al₁₃ sub-nano sized particles with the properties of halogen elements¹⁾.

In this study, we focused on bismuth as the constituent element, which is a typical metal element with a standard redox potential close to 0 V vs. SHE. The bismuth units were assembled in the dendrimers with controlling the number of atoms. Controlled blending with copper in the dendrimer was also investigated (Fig. 2). The finely controlled assembly enabled synthesis of sub-nano sized particles through a reducing process.

粒径 1 nm 程度のサブナノ粒子はバルクやナノ粒子とは異なる性質を示すことが報告されている。これはサブナノの微小粒子が特殊な電子状態をとることに由来する。我々はこれまでに、フェニルアゾメチンデンドリマーを用いた原子数の精密な制御法と、それを用いたサブナノ粒子合成を達成している (Fig. 1)。具体例として、ハロゲン元素の性質を備えた Al₁₃ サブナノ粒子の合成に成功している¹⁾。

本研究では用いる金属種として、標準酸化還元電位が 0 V vs. SHE に近い典型金属の Bi に着目した。個数を精密に制御した Bi を集積し、さらには Cu との配合集積を行った (Fig. 2)。また、それらを還元することでサブナノ粒子を合成したので報告する。

1) T. Kambe, N. Haruta, T. Imaoka, K. Yamamoto, *Nature Commun.* **2017**, 8, 2046.

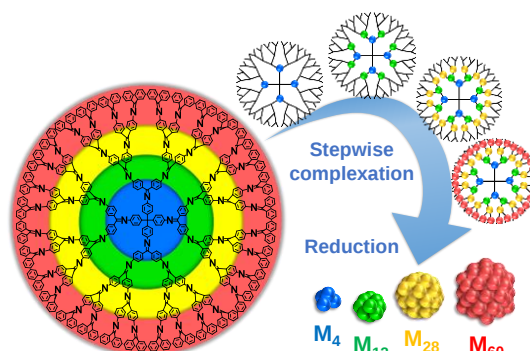


Fig. 1. Electron density gradient and stepwise metal accumulation in TPM G4.

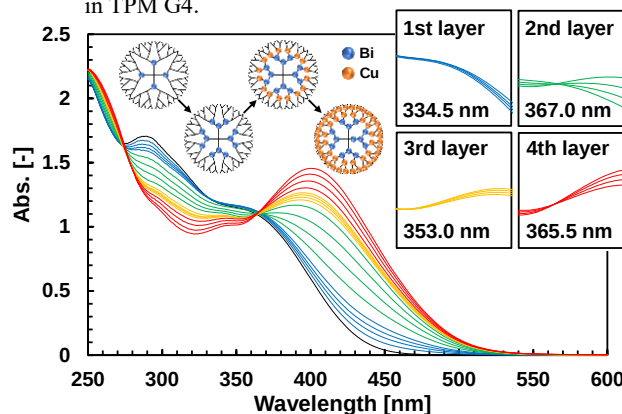


Fig. 2. UV-Vis spectral change of TPM G4 during addition of BiCl₃ (1-12 eq.) and CuCl₂ (16-60 eq.). Inset: Shift of observed isosbestic point.