日本―欧州　国際共同研究「超空間制御による機能材料」 2020 年度　年次報告書	
研究課題名（和文）	ナノ粒子からなる超分子構造体構築と多孔性ナノ材料への応用
研究課題名（英文）	Nanoparticle Supramolecular Frameworks as Advanced Nanoporous Materials
日本側研究代表者氏名	相田　卓三
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研究期間	2019 年　4 月　1 日　～　2023 年　3 月　31 日

1．日本側の研究実施体制

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２．日本側研究チームの研究目標及び計画概要

Research goal of the academic year 2020 was to optimize the preparation of comonomers and their hierarchical assembly into porous nanostructures. Comonomers (^{GroEL}AuNP) indicate a conjugate of gold nanoparticle (AuNP) and GroEL protein monomer building blocks that can link via complimentary DNA hybridization. The experiment plan includes changing the hydrodynamic diameters of AuNP (5–30 nm) and length of DNA on AuNP and GroEL (10–30 base pair) to prepare a series of comonomers. Number of GroEL on ^{GroEL}AuNP comonomers should be controlled in order to expect an ordered assembly. For instance, comonomers with 6 GroELs on ^{GroEL}AuNP can produce an octahedral pore in an assembled structure. We also aim to vary the shape of core nanoparticle such as gold prism and gold cube so that comonomers of different geometry can be prepared. One of the European partners is expected to synthesize this gold prism nanoparticle and send to the partner lab in Japan for DNA functionalization and comonomer synthesis.

3．日本側研究チームの実施概要

In the academic year 2020, we synthesized GroEL-conjugated AuNP (^{GroEL}AuNP) comonomers via DNA hybridization of DNA-appended AuNP (hydrodynamic diameter (D*h*) 5 nm and 20 nm) and DNA-appended GroEL protein. Number of GroELs on ^{GroEL}AuNP comonomer was 4–6 and 7–11 for a 5 nm- and 20 nm-AuNP, respectively. By using gradient centrifugation or electrophoresis technique we were able to purify the ^{GroEL}AuNP comonomers. Some of the planned experiments related to a different type of comonomer with European partners were not conducted due to COVID-19. We also investigated two preparation methods of nanoparticle supramolecular frameworks (NSFs). (1) One-pot synthesis wherein a mixture of $AuNP_{DNA}$ and $GroEL_{DNA}$ with complementary DNA sequences formed large size complexes according to the results obtained from dynamic light scattering. (2) Stepwise approach wherein the isolated ^{GroEL}AuNP comonomers assembled with a linker segment (i.e., a designed DNA or a $GroEL_{DNA}$) producing large size complexes. Further investigation towards the characterization of these assemblies, guest loading, and ATP-induced guest releasing is currently progressing.