Press Releases

May 14, 2013
JAMSTEC
Yokohama City University

Nanotechnology Inspired by Extreme Environments in the Deep Sea
-Making Nanoemulsions in Just 10 Seconds-

1.Overview
Shigeru Deguchi and his student from Institute of Biogeosciences, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC, Asahiko Taira, President) used unique properties of water at high temperature and high pressure to develop a novel bottom-up process for making nanoemulsions. The work was motivated by their interest in hydrothermal emissions from deep seafloor hydrothermal vents (Figure 1), where water is in the supercritical state (T_c = 374 ºC, P_c = 22.1 MPa) in some places. At such high-temperature and high pressure, water and oil freely blend (Figure 2). They developed a flow-type instrument that could reproduce the high-temperature and high-pressure conditions of hydrothermal vents in the laboratory (Figure 3), and successfully produced emulsions containing nano-sized oil droplets (less than 100 nm diameter) in water in less than 10 seconds (Figure 4). Unlike conventional emulsification processes where droplet formation occurs in a top-town manner by disrupting large oil droplets into smaller ones, droplet formation in the new process occurs in a bottom-up manner where oil molecules self-assemble to form nano-sized droplets (Figure 5). The new process, which is called MAGIQ(Monodisperse nAnodroplet Generation In Quenched hydrothermal solution), has several outstanding characteristics compared to conventional processes such as short processing time and versatility. It is anticipated that the process will be applied in manufacturing emulsion-based products in various industries including cosmetics, food, and pharmaceuticals. These findings are the fruits of a collaboration between JAMSTEC and Yokohama City University. The two organizations signed a graduate school collaborative agreement in 2005 and are working to strengthen education and research.

These findings were published online in *Angewandte Chemie International Edition* on May 13.

Figure 1. Hydrothermal fluids being ejected from a deep seafloor hydrothermal vent.

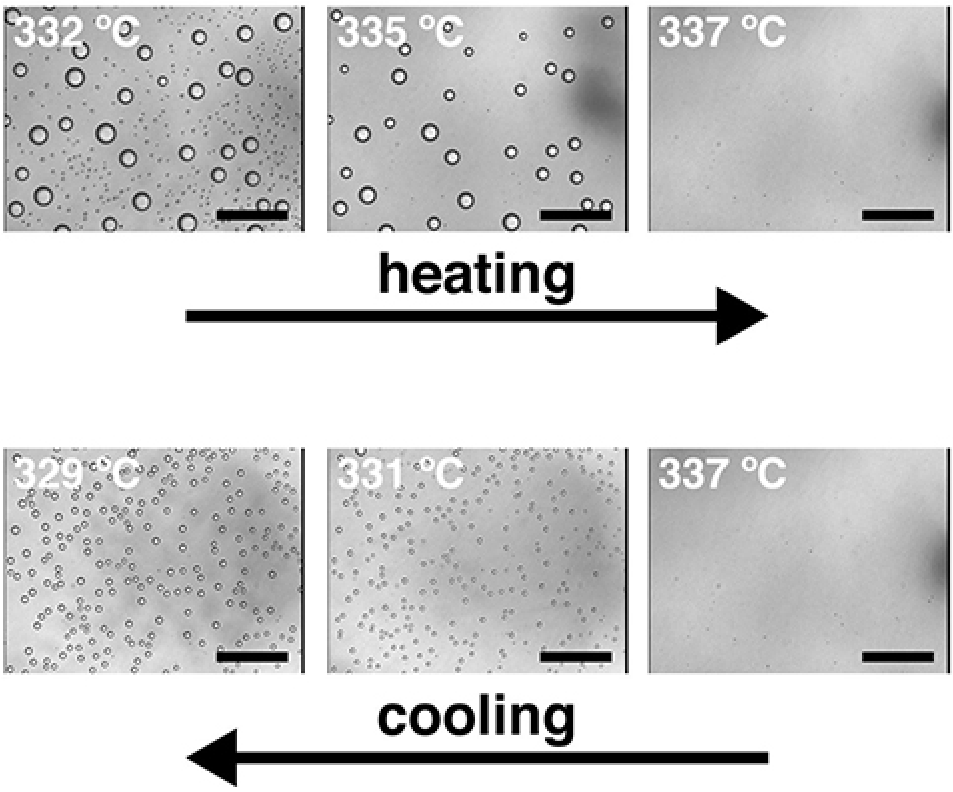

Figure2. A series of optical microscopic images illustrating the concept of MAGIQ.
Scale bars represent 0.1 mm.

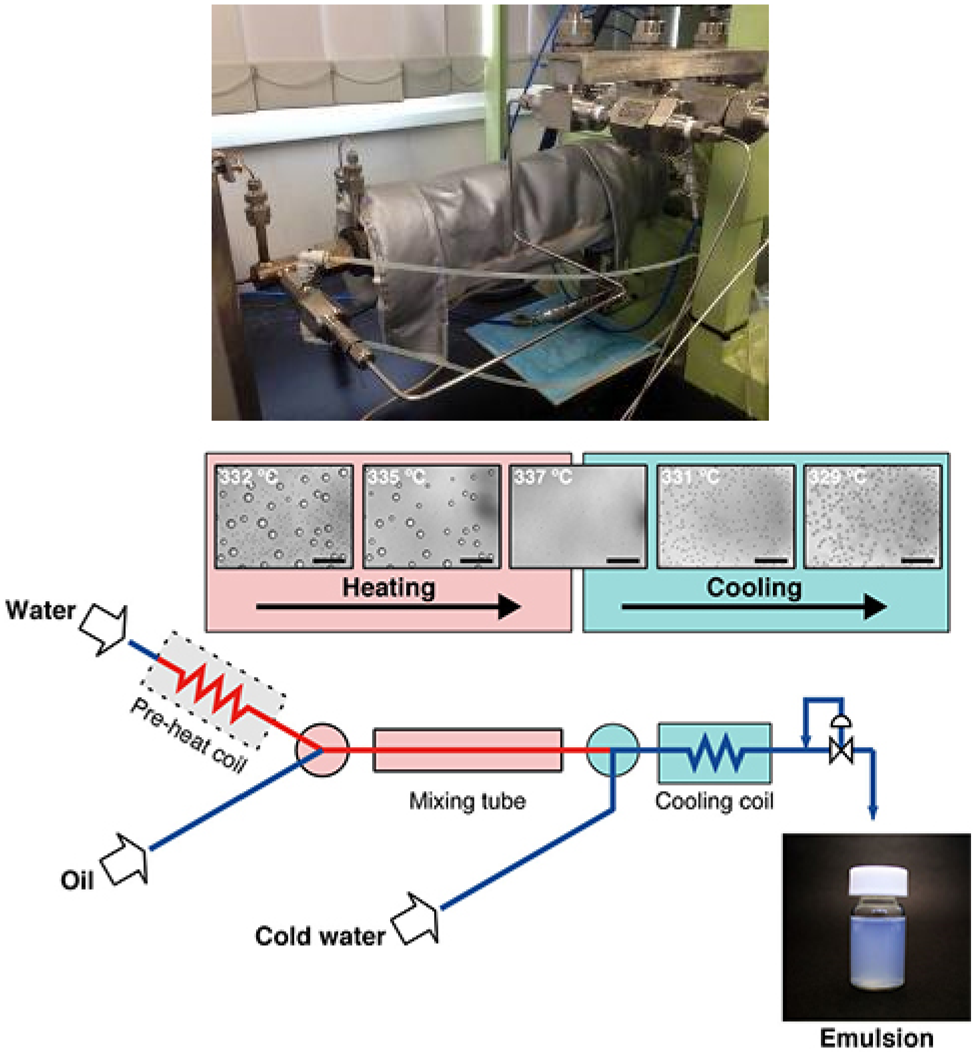

Figure 3. Photograph and schematic representation of a flow-type instrument to perform MAGIQ.

Figure 4. Comparison of a highly translucent nanoemulsion produced by MAGIQ (left) and a conventional emulsion containing micrometer-sized oil droplets (right).

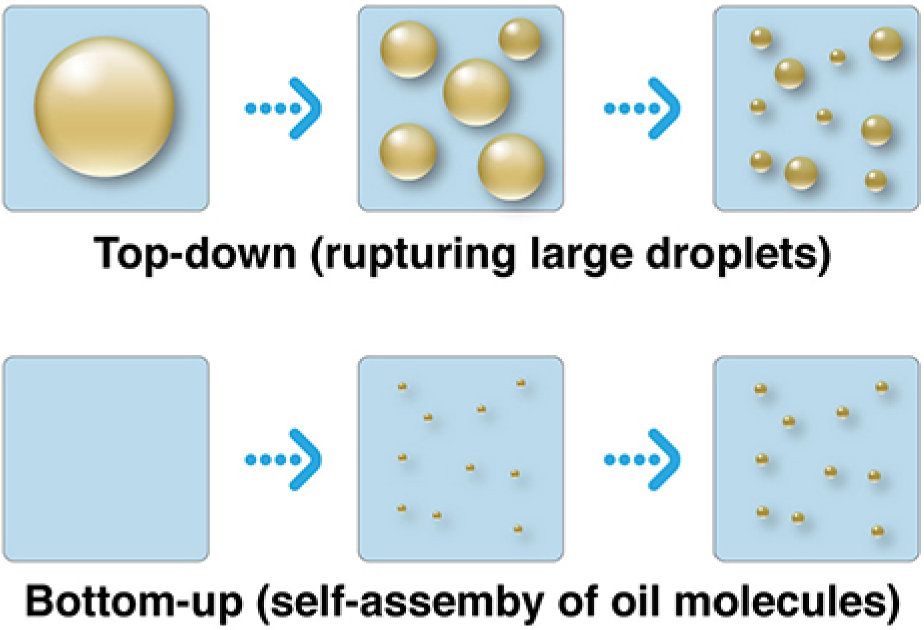

Figure 5. Top-down and bottom-up formation of fine oil droplets.

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