



Novel concepts and materials for microfluidic optical devices

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Abstract:

Energy concentration is essential to create compact, efficient microfluidic optical devices. Polyethylene glycol (PEG) is a suitable fluid for this purpose with its bipolarity (molecular solvability), nonvolatility, and high index of refraction (waveguiding). Its distinguished feature is a bistability in the phase transition process; i.e., a mixture of two PEG types (molecular weight: 300 and 2000), for example, takes both the liquid and solid phases in the temperature range of 20–38 °C. One can use this phase transition to pause a sample flow at a specific position in microchannels. The bistability also realizes a rewritable signboard with a PEG droplet array, since both the clear (liquid) and milk-white (solid) states are stable at room temperature. The strong scattering in the solid phase is useful to confine a light beam (photonic localization). Mirrorless lasers, which have been studied extensively with microdroplets, can be constructed with dye-dispersed PEG, since the confined fluorescence induces a stimulated emission. A bistable laser emission has been demonstrated in the phase transition process of the microfluid. The light confinement is also useful to enhance the absorbance of inorganic materials, which hardly absorb excitation or probe light particularly in a microchannel. Chemists have recently developed organic-inorganic hybrid phosphors with an enhanced excitation efficiency. Spectroscopic analysis of these hybrids needs time-resolved measurements, since both rapid and slow processes occur in organic ligands and metal ions. The time-space conversion spectral measurement is suitable for microfluidic devices, since a nanosecond resolution is attainable with no need for a large pulsed laser.



Biography:

Mitsunori Saito graduated from Kyoto University (Japan) in 1978 and received the PhD degree from Tohoku University (Japan) in 1991. After working as an associate professor at Tohoku University, he became a professor of Ryukoku University (Japan) in 1994.

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