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Reversible Gelation of Palladium-Based Fluid by Sound

Aggregating materials of low molecular weight by stimuli, electrochemically or with light, has been studied in gels, micelles, etc., to find ways to control fluidity, optical transmission, elasticity, and so on. Sound transmission increases molecular movement in liquids, but has not been considered suitable for molecular switching as it usually only breaks weak noncovalent interactions between molecules. Now, scientists in Japan (1) have developed the first molecule that is assembled by brief irradiation with ultrasound (sonication).

A dinuclear Pd complex, **1**, stabilised by an intramolecular π-stacking, but inert to forming associations, can instantly become jelly-like in various organic solvents upon exposure to sound. A clear, homogeneous solution of **1** was prepared by the reaction of $Pd(OAc)_2$ with *N*,*N*′-bis(salicylidene)-1,5-alkanediamines in boiling benzene (2). When placed in various solvents and irradiated with sound (0.45 W cm^{-2}, 40 kHz) for a few seconds, the stable sol state was completely converted to gel. For instance, a 1.2×10^{-2} M solution of **1** in acetone irradiated for 3 seconds at 293 K gave a totally opaque gel. Other organic solvents, such as CCl_4, 1,4-dioxane and ethyl acetate with **1** also gelled completely and instantly upon presonication for 10 seconds. However, without sonication these solutions remained stable at ambient temperature.

The resulting gels are readily converted back to the original solution by heating at above T_{gel}, followed by cooling to room temperature. The controllable switching can be repeated indefinitely as the gel transition is due only to a simple conformation change of the complex. The aggregation rate can be controlled between 'no gelation' and 'instant gelation' by tuning the sonication time.

Conventional self-assembly depends on static reaction parameters, such as temperature, concentration, solvents and additives, but sonication gives dynamic control to the aggregation rate, so is a useful addition to chemistry – and possibly industry.

References

1 T. Naota and H. Koori, *J. Am. Chem. Soc.*, 2005, **127**, (26), 9324

2 Japan Science & Technology Corp, *Japanese Appl.* 2003-261,859; 2003