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Ferrochemical materials

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Abstract

Amphiphilic molecules such as phospholipids, smectic liquid crystals or diblock copolymers are chemical dipoles which, under appropriate conditions, spontaneously line up side by side in a ferro-like chemical arrangement to form stable asymmetric monolayers. In three dimensions, these monolayers stack in a head-to-tail or anti-ferro like arrangement, which favors monopolar contact between similar species. It results in a symmetric bilayered lamellar material. Here we show how the use of triphilic rather than amphiphilic molecules will produce stable self-assembled smectic stacks with a fully polar, hence non centro-symmetric, ordering. We describe in details a generic model of such materials. It is made of a mixture of three triblock copolymers aBc, bCa and cAb with their end blocks twice sorter than the corresponding middle block. The three molecules line up in periodic columns such as aBc/cAb/bCa. Due to dipolar interactions, each neighbouring molecule has a unique orientation with respect to the three different chemical layers, and the composition of the whole material is oriented (ABC/ABC/ABC...). For instance, half (due to entropic mixing) of bCa molecules will match side by side with aBc/cAb. As a consequence, a polar structure with remarkable thermodynamic and mechanical stabilities is expected. We name these new materials “ferrochemicals”. In case where the molecules are triblock copolymers, the lamellar stack can be used as an organic matrix hosting and orienting inorganic Janus particles in order to get a large variety of hybrid polar materials with interesting non linear optical, ferromagnetic, or ferroelectric properties.

Biography

Dominique Ausserre has completed his Ph.D in 1985 in College de France, Paris. he joined the CNRS in 1986 and was a visiting scientist in IBM Almaden in 1987. He started a new lab in Institut Curie in 1988, and moved to Universite du Mans in 1991. He is director of research in CNRS since 1993. As the main inventor of the SEEC technique, he launched the start-up Nanoraptor in 2001. He has published more than 60 papers in reputed journals and filled about 15 patents, covering from instrumental optics to the physics of surfaces, complex fluids and polymers.