Perspectives for the Ferroelectricity in π-Conjugated Systems.

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Ferroelectricity is a demanded effect in fundamental and applied solid state physics. Till now, the ferroelectrics were known mostly as insulating inorganic materials. In this talk, we discuss a feasibility of obtaining ferroelectric, and the same time electronically and optically active, carbon-based materials: conducting polymers and graphene ribbons. Ferroelectricity related to the charge ordering was discovered in quasi-1D organic conducting crystals (TMTTF)\textsubscript{2}X \cite{1}, and extended to some layered BEDT based compounds. The interpretation was endorsed by understanding of the “combined Peierls effect” in conducting polymers \cite{2}. In both cases, the microscopic picture is based on two coexisting symmetry lowering effects: dimerizations of bonds and of sites: one of them being build-in, another comes as a spontaneous symmetry breaking. For a searched ferroelectric polymer, with respect to the (TMTTF)\textsubscript{2}X case, the origins of these dimerizations will be reversed. One such an (AB)\textsubscript{x} polymer has been already announced and studied for nonlinear optical properties \cite{3}, but not tested yet for the low frequency response which could have recovered the ferroelectricity. The theory \cite{2} predicts an existence of solitons with non-integer variable charges, both with and without spin, which are the walls separating domains with opposite electric polarisation. Their physics will serve to relate transient ferroelectric processes and the visible-range optics. For ribbons of graphenes, the zigzag edges possess the build-in dimerization of sites edge carbon atoms, while the spontaneous one may come from electron-phonon interactions.

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