Fabrication and study of piezoelectric fiber for self-energy textiles

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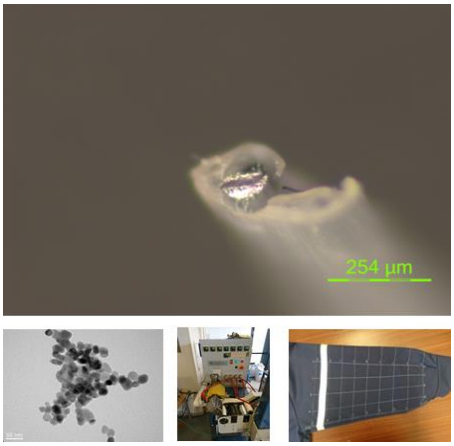

- Piezoelectric polymer
- Nanoparticles
- Crystallization oriented by oxides
- Sensor fiber
- Smart textiles

Abstract:
Smart textiles have different kind of captor which need electric power to work and usually a battery is used. But in some cases this battery could be an issue. This project has goal to develop a new fiber which could be generate electricity with the movements of body to improve the autonomy or replace the battery. Some polymers are already used to make the tissue of clothes, that is why we decided to study a piezoelectric polymer, the PVDF(polyvinydilene fluoride). The piezoelectricity is the property of materials which give an electric answer when they are deformed and vice versa. PVDF can crystallize in different phases: α, β, γ are the most common. However the α phase is a not piezoelectric phase, in contrary β and γ are piezoelectric. Usually the polymer is stretched to obtain β/ γ phase, but in our case we could not stretch it because we have metal core for the cathode in the fiber. That is why PVDF mixed with oxide nanoparticles have been considered as possible candidates to obtain piezoelectric fibers after recrystallization without stretching. The mixtures are studied in film form and are subjected to compression and tensile stress to determine the d_{33} and d_{31} piezoelectric coefficients of the products. A signal was systematically obtained with all selected oxides (ZrO_2 and Fe_2O_3) proving the piezoelectric property of the materials manufactured. A study on the mechanical behavior of a textile was carried out to determine the stresses that it undergoes during usual movements. Tissues respond in a transverse piezoelectric manner when the tensile stress is applied according to the fibers direction. Having also defined the intrinsic properties of the compound, it is possible, via simulation, to predict the amount of energy that can be harvested to power the operation of a sensor.