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Relevant parameters to increase the harvested energy of a ZnO nanowires-based nanogenerator

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Abstract. Harvesting mechanical energy from the environment to power an electrical device and making it autonomous is a real challenge. At GREMAN laboratory, the nanogenerators use a direct piezoelectric effect to convert mechanical energy into electrical one by using ZnO nanowires in a 1-3 piezo-composite structure. These nanogenerators work in a capacitive mode thanks to a dielectric polymer layer placed on the composite structure. Due to the different kinds of used materials inside the nanogenerator, different phenomena are involved in this application. The screening effect of the free electrons coming from the n-type semiconducting ZnO nanowires is one of the most important but polarization effects in the ZnO nanowires or in the polymer capacitive layer are also very important to take into account. This work provides some trends to follow to increase the yield of such a device by using a coupled piezoelectric and semiconducting model developed in Finite Element Method simulations with *COMSOL Multiphysics*®. Relevant intrinsic parameters such as diameter and surface traps density of the ZnO nanowires, dielectric permittivity and thickness of the polymer capacitive layer or extrinsic parameter such as resistance load are studied. The aim is to show how they modify more or less the harvested energy for a given mechanical excitation. By knowing which parameter changings have more impact than the others, nanogenerator design or materials choices can be adapted to increase the harvested energy.

Keywords: Energy harvesting, 1-3 piezo-composite, Semiconducting nanowire, Finite Element Method.