

Wrinkling patterns of electrospun nanofabrics in uniaxial tension

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Electrospun nanofabrics are gaining popularity in a variety of applications [1,2]. One such application is the use of nanofabrics, as enhancers of the mechanical performance of fiber-reinforced polymers (FRPs). The enhancement is realized through a multi-scale structure comprising the polymer matrix, the fibers which form the layered macro scale reinforcement and the nano-scale reinforcement introduced as interlayers [3]. Candidate nanofabric systems, were investigated in uniaxial tension in order to evaluate their potential as interlayer reinforcements.

This contribution, aims to bring forth wrinkling patterns that were observed in the transverse direction, during the performed tensile strength tests. The tests were performed with a custom-made tensile apparatus which provided force and displacement resolutions of 0.25N and 200 microns. The specimens used for tensile testing were two strips of nanofabric placed back to back, with gauge length between 122-125 mm, width 32 mm and thickness ranging between 9-16 microns per strip, depending on the nanofabric system. The testing was captured on video and the evolution of wrinkling patterns were inferred by video analysis.

We find that out of plane wrinkling initiates at small linear strains at the direction normal to the loading axis. In the post-wrinkling stage, mode-jumping is observed with higher frequency wrinkles at lower amplitudes, which manifest beyond the nanofabrics' yielding stress. Furthermore, wrinkling appears to be heterogeneous, in the sense that there are regions within the specimen that exhibit higher frequency wrinkles than others for the same loading increment, while there exist bands in between them that show none to minimal wrinkling. These phenomena will be juxtaposed to the measured stress-strain curves for a selection of the nanofabrics tested and will be discussed in relationship to existing analytical models [4] and the potential development of further analytical models to describe this response.

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[4] E. Cerda and L. Mahadevan, "Geometry and Physics of Wrinkling," *Phys. Rev. Lett.*, vol. 90, no. 7, p. 74302, Feb. 2003, doi: [10.1103/PhysRevLett.90.074302](https://doi.org/10.1103/PhysRevLett.90.074302).