



POSTER #22

THE EXOSKELETON OF SCORPIONS: FROM STRUCTURE TO MECHANICAL FUNCTION

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Along with the marine crustaceans - lobsters and crabs - scorpions belong to the phylum of arthropods, invertebrate animals having an external skeleton consisting of a stiff and strong material - the cuticle. The arthropod's cuticle has become a fundamental topic of study in the field of bioinspired materials due to its multifunctionality. Moreover, the cuticle structural configuration, comprising stiff chitin fibers embedded in a tough protein matrix with a certain degree of mineralization, has emerged as a novel approach in the preparation of innovative structural composite materials [1]–[5]. The multifunctionality of scorpion chela cuticle in particular, (e.g. defense, prey handling, and excavation, among others) leads to the development of a variety of types and distributions of mechanical stress. In the scorpion, the chela comprises the tibia (immovable finger and the base of the chela) and the tarsus (movable finger), with morphology varying among scorpion species (Fig. 1a-b).

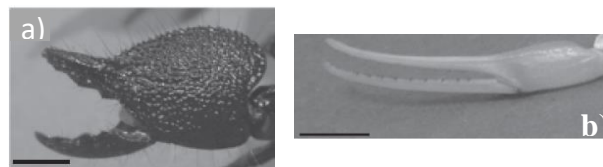


Fig. 1 The chela of a) *pandinus imperator* and b) *leivirus quinquestriatus* scorpions (scale bar 5 mm)[6]

The core objective of this research is to investigate the relationship between structure, mechanical properties and functionality of the cuticle of the scorpion chela.

In this study, we have defined for the first time, the hierarchical structure of the scorpion chela cuticle (fig. 2) in *Scorpio Maurus Palmatus* using a number of test methods such as scanning electron microscopy (SEM), Transmission electron microscopy (TEM), and energy-dispersive X-ray spectroscopy (EDS). Moreover, the defense behavior of the chela cuticle has been characterized using the nanoindentation technique.

These experimental approaches allow to visually understand the cuticle arrangement at different scales, and clarify why nature has created this kind of structures which are essential to the chela functionality.

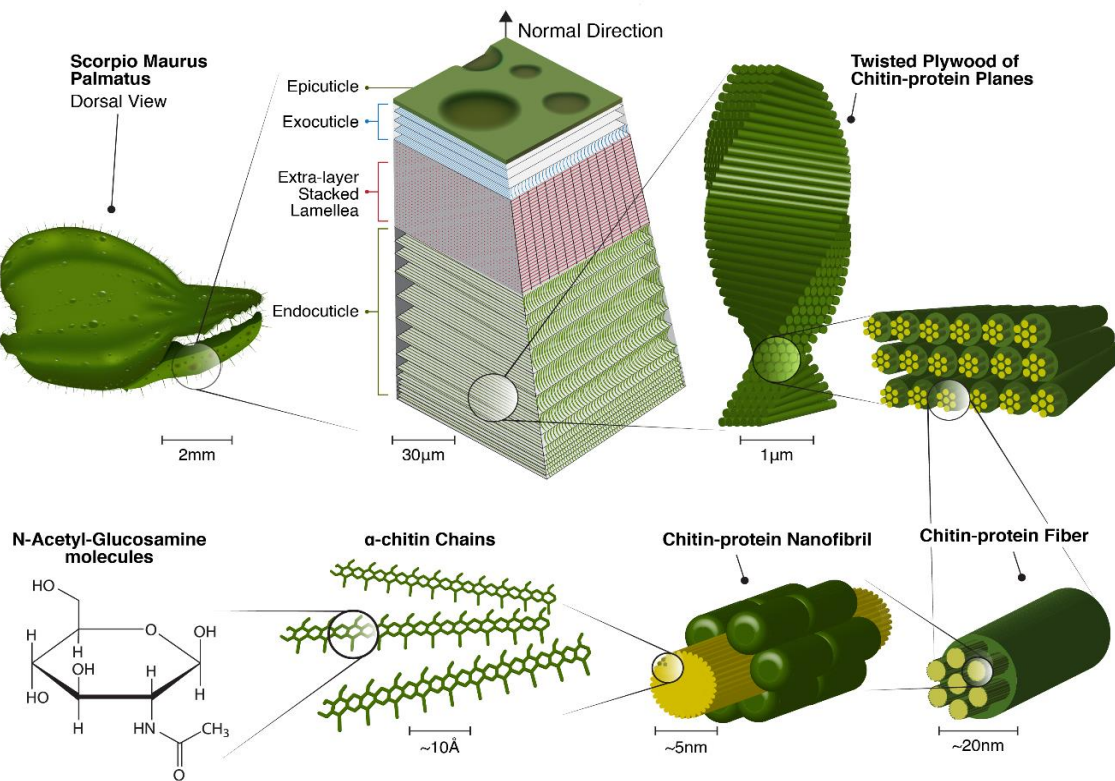


Fig. 2 Schematic illustration of the hierarchical structure of the *Scorpio palmatus* from the millimeter to the nanometer levels. Based on the preliminary observations of the present research and the literature.

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