

## Fracture of structured materials

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### ABSTRACT

We frequently find composite structures, especially comprised of soft and hard elements, in many strong materials in nature: timber, teeth etc. For example, in nacre, found inside of certain seashells, hard and brittle aragonite plates are glued together by soft and thin protein layers. Toughness of nacre is about 3000 times as high as that of pure aragonite, although the volume fraction of the soft protein is only 1/100! This presentation concerns, on a macroscopic level of continuum models, fracture properties of nacre and similar layered structures. We show that one of the important mechanisms of the enhancement of strength is a weakened stress concentration around the tip due to the structure by providing analytical solutions of crack problems in nacre-like layered materials (Fig. 1) in a simplified model [1].

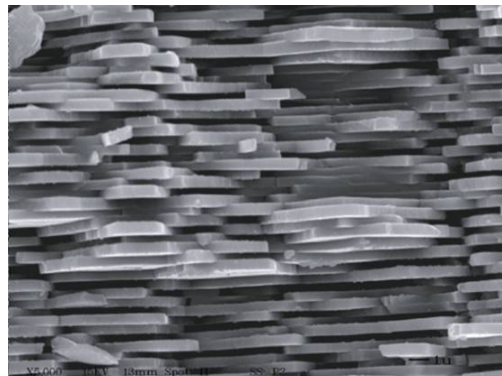


Fig. 1: nacre (courtesy of Prof. D. Katti)

In addition, we discuss the following two topics inspired by stereom of sea cucumbers or honeycomb etc.: [2] Experimental studies on fracture of soft cellular solids by using a model system of polyethylene foam (Fig. 2) and polyurethane foam by a hand-made setup, which propose new scaling laws, and [3] Toughening materials with its internal structure -- simple scaling arguments completed by simulations on simple models and experiments.

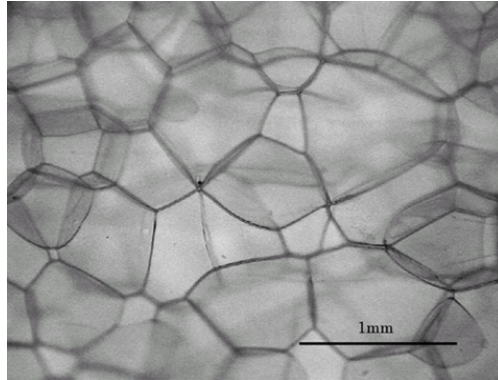


Fig.2: Polymer foam (Cellular Solid)

## REFERENCES

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