

Title: **Adhesion and Fracture of Soft Materials**

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Abstract:

Fracture of soft solids like an elastomer, a gel or a biological tissue is encountered in many different applications, e.g. cutting vegetables with the sharp edge of a knife at the mundane setting of a kitchen, puncturing with a sharp object like a hypodermic syringe needle in numerous medical processes and even in nature as the sucking tool of many insects, e.g. the “proboscis” of mosquitoes. In these different situations the ease at which the cutting or the puncturing tool incises the solid depends upon the geometry of the tool, its motion during cutting, incision or puncture and the coupled effect of these factors. We have examined these effects in the context of puncturing a soft hydrogel by a hypodermic syringe needle. Our experiments show that the needle does not puncture the gel continuously but intermittently with fracture progressing via alternate appearance of two different cracks: one ahead of the tool and the other radially away from it. In this talk I will discuss how asymmetry in geometry of the puncturing tool and its vibration can be employed for tuning the appearance of these cracks thereby minimizing the resistance to fracture. We will further extend these ideas in understanding the effect of geometry on adhesion and debonding of two different materials. Particularly, we will discuss about making soft surfaces decorated with hierarchical roughness patterns suitable for using as reusable adhesives and rewritable pads.