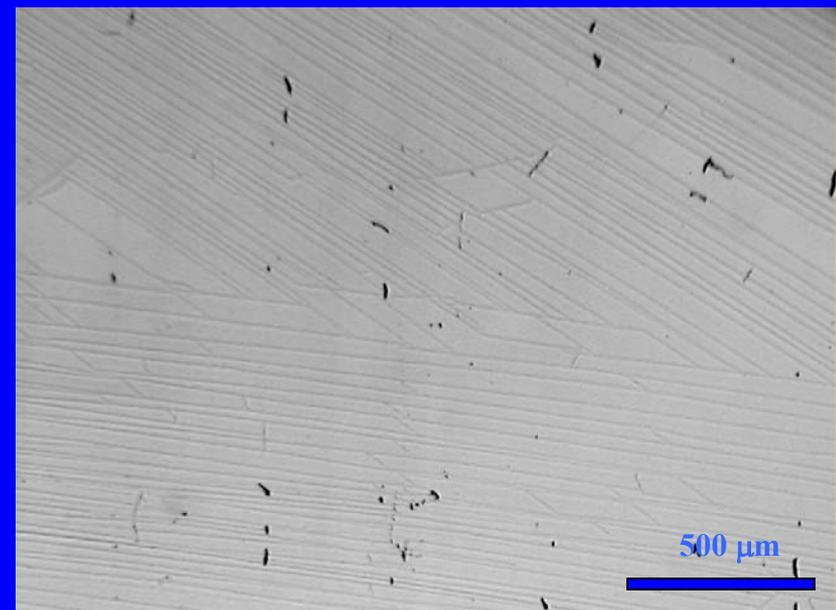
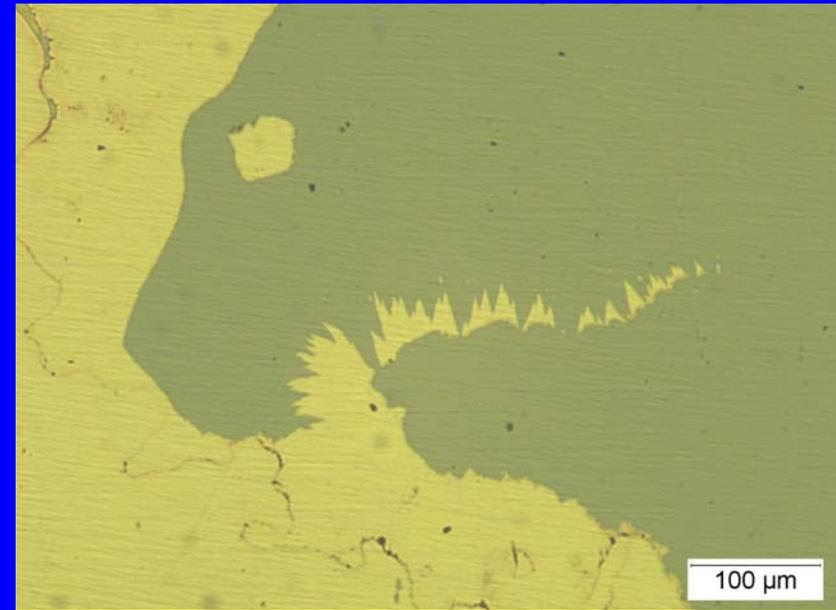


The Cracking of Thin Ceramic Films

Prof. Ivar Reimanis, Colorado School of Mines, 0103385

Thin ceramic films are employed in applications ranging from wear-resistant materials to flexible electronic circuits. Brittle films frequently crack unpredictably when the underlying substrate is deformed. This can be a frightening problem, illustrated here by the intriguing pattern formed when a **wear-resistant nitride film** cracked and peeled off a metal substrate (*top figure*). In the case of a **solar cell device**, (*bottom figure*), a complex array of cracks appears when the polymer substrate is only slightly deformed. Research funded by NSF has shown that the magnitude and orientation of residual stress in the film controls fracture and is extremely sensitive to the substrate type, leading to an inherent reliability issue in predicting conditions for fracture.



Undergraduate Senior Design of Materials

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During this project, the PI has worked with local industry and research centers in Colorado to create a realistic design experience for seniors enrolled in Materials Design: Synthesis, Characterization and Selection. Target areas include advanced technologies, such as **optical ceramics** and **biomaterials**. The figure on the right shows a former CSM student measuring the stiffness and hardness of a ceramic using a Nano Indenter. She worked in a team of three students, and in close collaboration with a local company, TDA Research Inc., in the design of an optically transparent ceramic. When students conduct projects on state-of-the-art materials and are made aware of current material limitations, they are much more marketable to industry.



“Working with transparent spinel ceramics in Senior Design was critical for me to get a job with CoorsTek Inc., the largest U.S. ceramics company.” Ms. Danielle Jansich (shown in photograph), B.S., CSM 2004.