Characterization of pollen adhesion to polyamides and polystyrene using atomic force microscopy

In nature, pollen presents significant allergenic potential only in the form of respirable-sized particles smaller than ~1 micron. Such small particles are produced by osmotic rupture when intact pollens (~20 micron) are exposed to water. These fragments can then be inhaled deeply into the lungs, or capillary and van der Waals forces strongly bind them to larger particles, including intact pollen grain surfaces. Pollen allergens are a leading cause of asthmatic episodes and allergies in the indoor environment. The adhesion of these particles to indoor surfaces (e.g., carpet fibers) is of tremendous importance to airborne particle distribution. The adhesive behavior of common ragweed (A. artemisiifolia) pollen grains to polyamides was studied by means of atomic force microscopy (AFM). Polymers employed were Nylon 6 (N6), Nylon 6,6 (N66) and polyamide 12 (PA12), with polystyrene (PS) as a control. The polyamides were chosen for our study as they are most often used as synthetic carpet fiber materials. For our work, pollen grains subjected to different water and alcohol treatments were used for the adhesion force measurements to determine the extent of allergen impact on adhesion. We attached a pollen grain to the tip of the AFM cantilever by means of epoxy glue and a micromanipulator. This ‘colloid' probe technique was then used to measure the pollen adhesion force with the polymer surfaces. Comparison was made between the strength of pollen adhesion and the polymer surface energy and pollen particle fragmentation method.