

Scientific approach to plasma technologies

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The basic principle of plasma technologies is the modification of surface properties of solid materials by treatment with species of high potential and/or kinetic energy. The surface finish usually depends on the dose of plasma species (charged particles, neutral radicals, and radiation) and sometimes also on the fluxes of plasma species. Scientific literature, however, rarely reports the fluxes or doses. Instead, it reports the peculiarities of the experimental system, the discharge coupling and power, the gas pressures and flows, and the treatment time. The lack of information about the fluxes and doses disables the upscaling of the scientific results to the industrial level. The scientific approach to plasma functionalization and wettability of organic materials will be presented. It will be shown that the evolution of the surface wettability of numerous polymers depends only on the dose of neutral atoms and marginally on other parameters such as the discharge power, gas pressure, and treatment time. Knowing the required dose for a desired wettability thus enables upscaling, which is merely a technological, and not a scientific challenge. The desired surface finish of many polymers is achieved by treatment with oxygen plasma, while a two-step process should treat some polymers (especially fluorinated). First, the polymer is exposed to plasma which is a significant source of vacuum ultraviolet radiation, and then to a mild oxygen plasma or its afterglow. The first step enables bond breakage in the surface film and the second functionalization with polar functional groups. The two-step process allows a super-hydrophilic surface finish of many polymers, including Teflon.

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