Improving the anti-scratch resistance of transparent urethane acrylate UV coatings by incorporation of chemically-modified graphene oxide.

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The use of ultraviolet (UV) cured resins is a good alternative to the conventional solvent based resins due to several reasons: low activation energy, low curing temperature (even room temperature curing), high hardness of the final coating and negligible emission of volatile organic compounds. Polyurethane-acrylate resins are commonly used as protective coatings in applications that require high resistance to degradation and high mechanical performance. The key features of a protective coating are its anti-scratch resistance and transparency. The anti-scratch resistance can be enhanced by using inorganic fillers such as nanosilica, zirconia or even carbonaceous materials as graphene and its derivatives. Graphene oxide (GO) is a material obtained from the oxidation and exfoliation of graphite (chemical route) and it can be considered a functionalized graphene. GO is the most common graphene derivative used due to its mechanical properties. In this work, transparent UV-curable urethane acrylate coatings with high anti-scratch resistance were fabricated. Their anti-scratch resistance was further enhanced by the addition of different graphene derivatives. To achieve this, the surface chemistry of a commercial graphene oxide was modified to improve the interaction of the filler with the urethane-acrylate matrix. Here, four fillers were used: as-received GO, chemically reduced GO, GO functionalized with vinyltriethoxysilane (VTES) and GO functionalized with VTES and subsequently reduced with hydrazine. As a result, the anti-scratch hardness of the urethane-acrylate coating was improved above the Wolf Wilburn scale limit (9H) while keeping a high degree of transparency.