

Na Doped ZnO UV Filters with Reduced Photocatalytic Activity for Sunscreen Application

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Abstract : In the past two decades, the concern for skin protection from ultraviolet (UV) radiation has attracted considerable attention due to the increased intensity of UV rays that can reach the Earth's surface as a result of the breakdown of ozone layer. Recently, UVA has also attracted attention, since, in comparison to UVB, it can penetrate deeply into the skin, which can result in significant health concerns. Sunscreen agents are one of the significant tools to protect the skin from UV irradiation, and it is either organic or inorganic. Developing of inorganic UV blockers is essential, which provide efficient UV protection over a wide spectrum rather than organic filters. Furthermore inorganic UV blockers are good comfort, and high safety when applied on human skin. Inorganic materials can absorb, reflect, or scatter the ultraviolet radiation, depending on their particle size, unlike the organic blockers, which absorb the UV irradiation. Nowadays, most inorganic UV-blocking filters are based on (TiO₂) and ZnO). ZnO can provide protection in the UVA range. Indeed, ZnO is attractive for in sunscreen formulation, and this relates to many advantages, such as its modest refractive index (2.0), absorption of a small fraction of solar radiation in the UV range which is equal to or less than 385 nm, its high probable recombination of photogenerated carriers (electrons and holes), large direct band gap, high exciton binding energy, non-risky nature, and high tendency towards chemical and physical stability which make it transparent in the visible region with UV protective activity. A significant issue for ZnO use in sunscreens is that it can generate ROS in the presence of UV light because of its photocatalytic activity. Therefore it is essential to make a non-photocatalytic material through modification by other metals. Several efforts have been made to deactivate the photocatalytic activity of ZnO by using inorganic surface modifiers. The doping of ZnO by different metals is another way to modify its photocatalytic activity. Recently, successful doping of ZnO with different metals such as Ce, La, Co, Mn, Al, Li, Na, K, and Cr by various procedures, such as a simple and facile one pot water bath, co-precipitation, hydrothermal, solvothermal, combustion, and sol gel methods has been reported. These materials exhibit greater performance than undoped ZnO towards increasing the photocatalytic activity of ZnO in visible light. Therefore, metal doping can be an effective technique to modify the ZnO photocatalytic activity. However, in the current work, we successfully reduce the photocatalytic activity of ZnO through Na doped ZnO fabricated via sol-gel and hydrothermal methods.

Keywords : photocatalytic, ROS, UVA, ZnO

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