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High Speed Roll-to-Roll Deposition of TiO_2 Thin Films by a Hybrid Plasma/ CVD Method at Atmospheric Pressure and Low Temperature

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The deposition of robust titanium dioxide coatings at low temperature and at high roll-to-roll speed remains challenging. While low pressure processing methods show strong limitations for high speed roll-to-roll deposition, atmospheric pressure processes, avoiding the use of vacuum systems are promising. Atmospheric pressure plasma methods are currently widely studied and reported in the literature for the deposition of TiO_2 thin films, because of their ability to deposit coatings at low temperature and high deposition rate [1,2].

In this work, a new atmospheric pressure hybrid deposition method operated in open-air combining Chemical Vapor Deposition (CVD) and plasma treatment is developed in order to deposit resistant titanium dioxide coatings. Dense and resistant good quality coatings are successfully deposited at low temperature and high roll-to-roll speed. The importance of the plasma in the process and growth mechanism of the coatings is assessed by comparing coatings deposited by CVD and by plasma/CVD hybrid method in identical conditions. Morphology and deposition rate are determined by SEM observations. XPS is performed to investigate the chemical composition of the coatings. Optical properties are assessed by UV-visible spectroscopy and scratch tests are performed to assess the effect of the plasma to form scratch resistant coatings. The low temperature of the process allows the deposition of the resistant UV absorbing coating on heat sensitive substrates such as polymers, to provide UV and scratch protection. The high roll-to-roll speed makes this method industrially interesting for TiO_2 coatings deposition.

References:

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