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使用纳米二氧化钛建筑材料的光催化作用对有毒污染物进行补救：综述

斯里尼瓦劳·辛格，迪尔沙德·泰吉，乌沙达卡，洛克·巴纳瓦特
(所属单位：印度建筑研究部)

摘 要：纳米二氧化钛，由于其独特的光催化和疏水特性，可用于制备自清洁的水泥基智能建筑材料。正二氧化钛通过其光催化作用降解有机和无机污染物，并将其转化为无毒的副产品，即改善空气质量。在这篇综述中，概述了纳米二氧化钛的合成方法、纳米二氧化钛在水泥基材料上的负载方法、光催化性能、自清洁机制以及纳米二氧化钛在水泥基材料中的应用等方面。此外，二氧化钛可作为涂料或添加剂用于路面砖、斑马线的砂浆/混凝土、道路隔离带和衬里以及高层建筑。此外，在水泥基材料中使用纳米二氧化钛的影响和经济方面显示，与传统建筑材料相比，纳米二氧化钛的材料成本增加了约 27%，（101 至 128.1 美元）。此外，低成本的碳化材料，如生物炭，被建议用作纳米二氧化钛的载体，以降低成本并提高光催化混凝土的修复效率。

关键词：纳米二氧化钛；智能建筑材料；自清洁；污染物修复

Remediation of Noxious Pollutants using Nano-titania-based Photocatalytic Construction Materials: A Review

Srinivasrao Singh, Dilshad Tyagi, Usha Dhaka, Lok Banavath
(Affiliation: Department of Building Research, India)

Abstract Nano-titania (n-TiO2), due to its unique photocatalytic and hydrophobic properties, can be used to prepare self-cleaning cementbased smart building materials. The n-TiO2 degrades organic and inorganic pollutants through its photocatalytic action and convert them into non-toxic by-products, i.e., improves the air quality. In this review, aspects such as methodologies of n-TiO2 synthesis, approaches for n-TiO2 loading on cementitious materials, photocatalytic properties, self-cleaning mechanism, and application of n-TiO2 in cement-based materials have been overviewed. Further, the n-TiO2 can be used either as coatings or admixtures in pavement blocks, mortars/concrete at zebra crossings, road dividers and linings, and high-rise buildings. Moreover, the implications and economic aspects of n-TiO2 usage in cement-based materials revealed that n-TiO2 increases the material cost by ~ 27%, (101 to 128.1$) in comparison to conventional building materials. Furthermore, the low-cost carbonized materials such as biochars have been suggested to be used as support of n-TiO2 to lower the cost and improve the remediation efficiency of photocatalytic concrete.

Keywords Nano-titania; Smart building material; Self-cleaning; Pollutant remediation

一、引言

SMOG

200

8%

SOx NOx CO

VOCs

VOCs

SiO2 ZnO2 Al2O3 TiO2 CNTs

e-

/ h+

VB CB

O2-

TOTO OH-

四、将纳米二氧化钛掺入水泥基材料的方法

i

ii

二、纳米材料和水泥复合材料

五、与胶凝材料混合

Graziani

/

/ Lackhoff

Chen Poon

TiO2-

Jubilee

Fe2O3

Fe2O3

Al2O3

/ CNTs/CNFs

TPa GPa CNTs

CNFs

六、混凝土的表面涂层

三、纳米钛合金

-

0.05

/ 30

5

5%
100%
- -

Maury-ramirez -

86%
-

Chen
8
5 95% NO
89% NO
PURETI 99% HO-
1%
40

PURETI TiO2
H2O
OH-

Li
NO
TiO2

七、工艺参数对光催化的影响

Dell'Edera

503 354 m2
/g 15% -85%brookite 53% -
47%brookite
TiO28 h TiO216 h

八、催化剂负载的影响

九、温度的影响

O2

0 12 24 36

十、纳米二氧化钛的工业应用和毒性

/

Erdem

16.2 45.8
96
/ 401 / Lin
LC50

PM2. 5 (iii)
(iv)

十一、纳米二氧化钛在水泥基材料中的经济方面应用

(v)

-

Stat Nano

32 180

5 15 18

30 40 100 800 1500

235 198 108 298

198 195 136 195

~27% 101 128.1

结论

27%

i

ii

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