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Advanced Nanomaterials as UV Photocatalysts for IAQ Monitoring

Ayesha Kausar[1,2,3]*, Ishaq Ahmad[1,2,3], Zhu Tianle[4] and Eisa MH[5]

[1]NPU-NCP joint international research center on Advanced Nanomaterials and Defects engineering, Northwestern Polytechnical University, China

[2]UNESCO-UNISA Africa Chair in Nano-sciences/Nanotechnology, iThemba LABS, South Africa

[3]NPU-NCP joint international research center on Advanced Nanomaterials and Defects engineering, National Centre for Physics, Pakistan

[4]School of Space and Environment, Beihang University, China

[5]Department of Physics, College of Science, Imam Mohammad Ibn Saud Islamic University (IMSIU), Saudi Arabia

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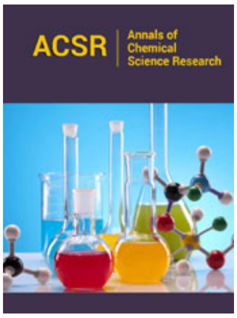

***Corresponding author:** Ayesha Kausar, NPU-NCP joint international research center on Advanced Nanomaterials and Defects engineering, Northwestern Polytechnical University, Xi'an 710072, China and National Centre for Physics, Islamabad 44000, Pakistan, UNESCO-UNISA Africa Chair in Nano-sciences/ Nanotechnology, iThemba LABS, Somerset West 7129, South Africa

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Abstract

Nowadays, indoor air pollution has emerged as a major health concern for the indoor living population. UV photocatalytic indoor air cleansing has been found to be a promising technology. Effective UV photocatalysts have been applied to monitor/control the indoor air quality (IAQ) level. The nanomaterials based on nanocarbons, polymers, and nanoparticles have been applied in the UV photocatalysts. Indoor pollutants including gaseous pollutants, organic compounds, and biological pollutants have been removed using photocatalytic technology. Basically, nanomaterials act to degrade the environmental pollutants into environmentally safe forms, i.e., least hazardous for human health and maintain the IAQ level. Accordingly, through the use of nanomaterial-based UV photocatalysts, future solutions linking the IAQ regulation to the novel nanomaterials have been achieved.

Keywords: UV photocatalyst; Nanomaterial; IAQ; Pollutants; Polymer; Nanoparticle

Introduction

Indoor air pollution sternly threatens human health and the efficient treatment technologies were found indispensable [1]. Various advanced technologies have been studied for controlling indoor air quality (IAQ) [2]. However, few technologies have been found effective to develop equilibrium removal capacity for the indoor air pollutants [3]. The catalysts based indoor air purification techniques have gained significance due to high surface area and enhanced removal efficiency for indoor pollutants even at low concentrations [4]. In this regard, the UV photocatalyst based on the nanomaterials have gained research interest [5]. Employment of UV photocatalyst based air cleaning technologies improve IAQ by the removal of particulates, volatiles, biological, and gaseous species [6]. The nanocarbon, polymer and metal oxide nanoparticle-based UV photocatalysts have been developed and applied in the indoor systems [7]. Further growth of this technology has been desirable to remove these hazardous air pollutants from indoor buildings [8-10]. Photocatalytic efficiency has improved with the use of nanomaterials. In this article, the use of photocatalyst and nanomaterial-based UV photocatalysts has been explained for the indoor air pollutant removal. The deployment of UV photocatalysts in IAQ monitoring devices has been found essential to avoid the harmful health effects of indoor activities on human health.

UV photocatalysts

To remove indoor air pollutants, a UV photocatalyst have been used [11]. The UV photocatalyst functions via oxidation of the harmful indoor air species such as particulate matter, bacteria, fungi, and gaseous pollutants [12]. UV photocatalysts may cause oxidation to decompose the harmful indoor particles and also adsorb the gaseous and biological particles [13]. Basically, the redox reactions have been found to degrade the adsorbed species on the photocatalyst surface [14]. UV catalytic degradation has been observed to be effective and least energy consuming. Thus, photocatalytic oxidation has been proposed as an ideal technology for indoor air purification. UV photocatalytic degradation also possess the advantage of large-scale processing facilities and is not limited by environmental factors. The basic function of the UV photocatalysts is to convert the indoor air pollutants into non-toxic or less harmful forms for human health.

Nanomaterial based UV photocatalysts

Nanomaterials have a strong tendency to deal with particulate matter, volatile organic matter, COx, NOx, SOx, and other indoor environmental pollutants [15,16]. Especially, in the form of UV photocatalysts, nanomaterials may remove the indoor pollutants and prevent the health hazards like allergies, lungs diseases, stress, neural diseases, and sick building syndrome [17,18]. UV photocatalysts not only prevent indoor pollution but also avert the ozone depletion problems [19]. Various nanomaterials have been used to design high-performance UV photocatalysts. Carbon nanotube-based UV photocatalysts have been applied to remove volatile organic matter from indoor air [20,21]. Carbon nanotube and TiO_2 derived nanocomposites have also been prepared for UV photocatalysts to deal with indoor air pollution [22]. Moreover, the polymer and TiO_2 nanocomposites have been prepared [23-25]. The polystyrene/TiO_2 nanocomposites have been designed for IAQ monitoring [26]. Furthermore, the poly(vinylidene fluoride)/ TiO_2 nanocomposite as UV photocatalyst removed the indoor volatile organic matter [27]. The poly (vinylidene fluoride)/graphene/TiO_2 nanocomposites have shown significance as UV photocatalyst for IAQ regulation [27]. In the nanomaterial based UV photocatalyst, inclusion of nanoparticles facilitated the electron mobility and enhanced the photocatalytic activity for the decomposition of indoor pollutants [28]. Incidentally, the easy recovery of the catalytic materials has been observed with improved photocatalytic efficiency, compared with the conventional catalytic systems [29,30]. Figure 1 shows the role of nanocomposite-based UV photocatalyst to degrade the indoor air pollutants.

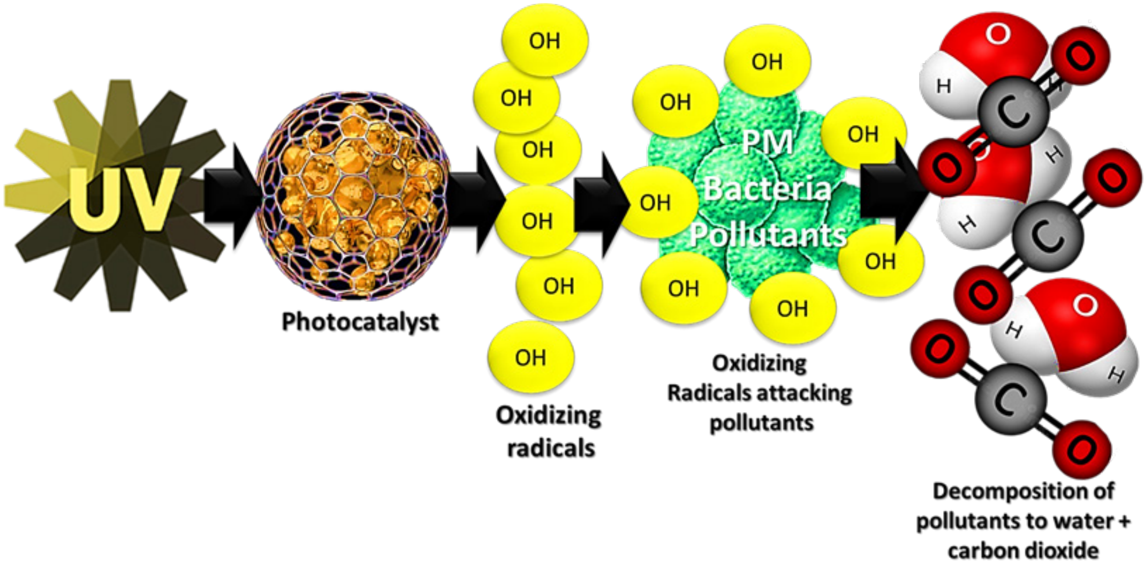

Figure 1: Role of nanomaterial UV photocatalyst for decomposition of indoor pollutants.

Conclusion

In this short review, a transitory demonstration of the nanomaterials-based UV photocatalytic materials was accomplished for monitoring the IAQ level. The great advantages of using nanomaterials as photocatalysts have been observed to remove indoor pollutants. These photocatalyst become active in UV light and degrade the indoor pollutants. The importance of nanomaterials has also been analyzed in replacing the traditional catalyst for indoor air purification. In future, large-scale production of UV photocatalysts need to be investigated for the establishment of commercial IAQ monitoring systems.

Conflict of Interest

Authors declared no conflict of interest.

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