# Preparation of $TiO_2$-Coated Polypropylene Beads by PCVD Process for Phenol Removal

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**Abstracts:** Polypropylene beads (PP) coated with $TiO_2$ thin films were prepared by a rotating cylindrical plasma chemical vapor deposition (PCVD) reactor and were used to remove phenol in aqueous solution. The $TiO_2$ thin films of 416 nm thickness were coated on the PP particles uniformly. As the number of $TiO_2$-coated PP beads increases, the phenol is degraded faster, because of larger total surface area of photocatalysts for photodegradation. This study shows that a rotating cylindrical PCVD reactor can be a good method to prepare the particles coated with high-quality $TiO_2$ thin films, which can be applied to the pollutant removal by a photodegradation reaction of $TiO_2$ with high efficiency.

## 1. Introduction

The $TiO_2$ photocatalysts have many unique photocatalytic properties and they can be applied to air and water pollutants removal, VOCs decomposition, water splitting, etc[1]. Karches et al.[2] coated the $TiO_2$ films on the glass microbeads as photocatalysts for water treatment by the circulating fluidized bed plasma chemical vapor deposition (PCVD) reactor. Kim et al.[3] proposed a rotating cylindrical PCVD reactor for uniform particle coating and they suggested that the rotating PCVD reactor could be used to provide thin films on particles with higher quality, as compared with other particle-coating processes. In this study, we coated the $TiO_2$ thin films on the polypropylene (PP) beads by a rotating cylindrical PCVD process and used those PP beads to measure the removal efficiency of phenol in aqueous solution.

## 2. Experiments

To coat $TiO_2$ thin films on the PP particles in the size of 3 mm, we used the rotating cylindrical PCVD reactor. A water-cooled spiral-shape coilelectrode is located outside the cylindrical reactor to generate the inductively coupled plasmas. The rotation speed of the cylindrical quartz reactor was controlled by a DC motor. The cross sectional views of the $TiO_2$ thin films coated on the PP beads were measured by SEM for various process conditions and they were used to obtain the film thicknesses coated on the PPs beads. We used a slurry type batch reactor of 300 ml volume to measure the efficiency of phenol removal by $TiO_2$ **p**hotodegradation. The phenol aqueous solution with $TiO_2$-coated PP beads was stirred continuously by magnetic stirrer. The UV lamp (wavelength < 365 nm, 1100 $\mu W/cm^2$) was placed in the center of the batch reactor. To examine the degradation efficiency of phenol, the concentration of phenol in the solution was measured by UV-Vis spectrophotometry.

## 3. Results and Discussion

Fig. 1 shows SEM image of the cross section of $TiO_2$ thin films coated on the 200 PP beads after deposition of 20 min. In. Fig. 1, the $TiO_2$ thin films of 416 nm thickness were coated on the PP beads uniformly. Fig. 2 shows the change of phenol concentration for various numbers of $TiO_2$-coated PP beads in the solution. The degradation rates of phenol become faster with increasing the number of those PP beads because the total surface area of photocatalysts for photodegradation becomes larger.

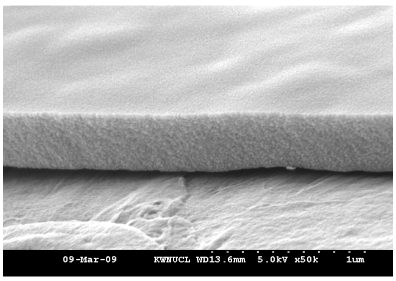


Fig. 1. SEM image of cross section of $TiO_2$ thin films coated on the 200 polypropylene beads ($t_D$ = 20 min, $\omega_R$ = 10 rpm).

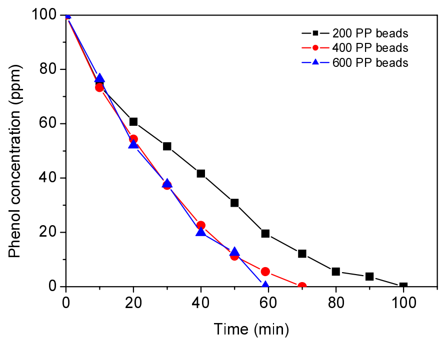


Fig. 2. Change of phenol concentration along the reaction time for various numbers of PP beads.

## References

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