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Synthesis of Mesoporous TiO_2-SiO_2 Binary Oxides Photocatalyst by Sol-Gel Method Using *Sodium Dodecyl Sulfate* (SDS) as Template

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ABSTRACT

Effects of SDS concentration and conditions on the formation of mesoporous TiO_2-SiO_2 binary oxides by sol-gel process. The investigation was conducted because the curing and crystallization time will affect the photoatalytic properties of this material. The binary oxides were composed of TiO_2-SiO_2 anatase nanocrystalline. The rough and porous surfaces of samples were prepared of SDS 20% from the amount of precursor. The BET specific surface area of the samples changed from 101.2 to 282.2 m^2g^{-1} for a sol time of 8 hours when the SDS concentration was 20%, calcination temperature was 500^{0}C during 3 hours with varied durations and gel process was 15 hours, moreover, the average pore size decreased from 34 to 30.6 Å. The results show that the mesoporous TiO_2-SiO_2 binary oxides are expected to have the maximum photo catalytic activity and high adsorption capacity.

Keywords : Mesoporous, TiO_2-SiO_2, binary oxides, SDS, photocatalyst

INTRODUCTION

Titanium dioxide (TiO_2), a semiconductor photocatalyst which worked when exposed to UV or Visible. Use of light associated with the properties of this material such as, morphology structure of TiO_2. Some researchers have attempted to modified the structure of TiO_2 photocatalyst to an increase in the effectiveness of the catalyst performance during used. Related morphology was have performance nanostructure anatase, nanoporous, particles distribution on the surface and a large specific surface area.

In this research, using a modified of the support SiO_2 matrix, chitosan as a directional printed template porous and anionic surfactant Sodium Dodecyl Sulfate (SDS) as a distribution of the porous surface to event and homogenous. In the synthesis of TiO_2-SiO_2 binary oxides photocatalyst by sol-gel methods, process parameters need to be conditioned, because it affect the crystal growth of TiO_2-SiO_2. At different process conditions will result in different morphology properties of the product. This study aim to observe the effect of the anionic surfactant SDS and the duration of curing the sol-gel, calcination process on the morphology proporties changes nanoporous of TiO_2-SiO_2.

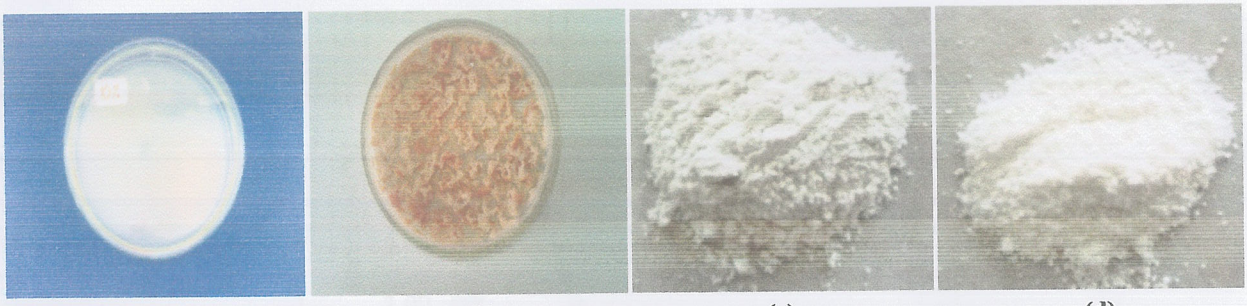
EXPERIMENTAL

Materials and Instruments

Synthesis of TiO_2-SiO_2 Binary Oxides

Mixtures Sol of TiO_2-SiO_2 consists TTIP, TEOS and DEA as aditive in the isopropanol solution. Molar ratio of Ti : Si (1: 1 and 2: 1). To the mixture was added anionic surfactant SDS and chitosan with molar ratio (1:1) in 5% acetic acid. Sol mixture was conditioned for 8 hours to obtain a stable and homogeneous, and then curing gel at temperatures at 100-110°C for 15 hours. Then, calcination at a temperature of 550°C for 3-5 hours, and TiO_2-SiO_2 powder were characterized by SEM, PSA and BET/BJH.

RESULT



(a) (b) (c) (d)

Fig 1. Crystallinity Process TiO_2-SiO_2 Powder, the composition chitosan 20% and SDS 20%. (a). Sol 8 hours at room temperature, (b). Gel curing 15 hours at a temperature of 100-110°C, Calcination at temperatur 500°C for (c) 3 hours and (d) 5 hours

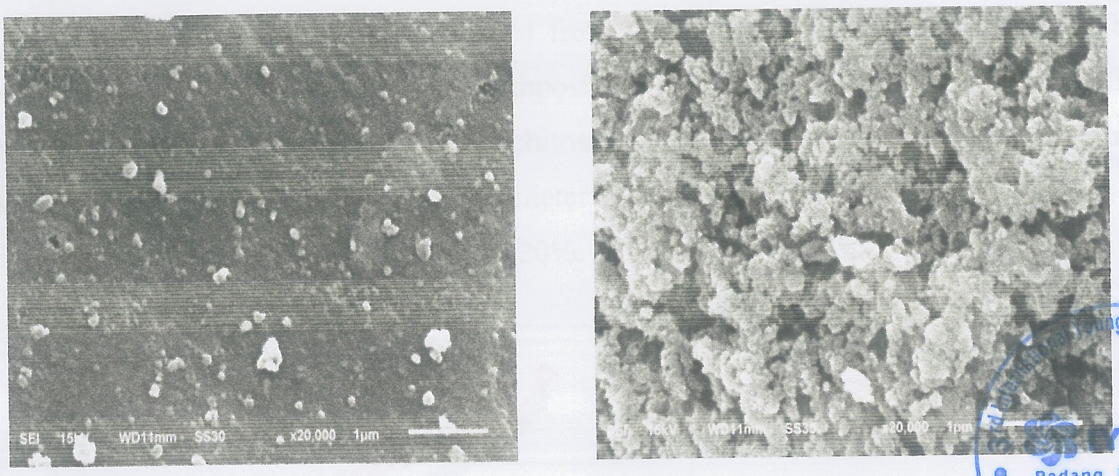


Fig 2. Pattern of Surface Morphology of (a). TiO_2-SiO_2 (2:1), SDS 20% and (b). TiO_2-SiO_2 (2:1), chitosan 20 % and SDS 20%, Analysis of SEM at 20.000 times

The effects of chitosan and SDS on the composition of the precursor Ti and Si, affected morphology properties. Appearance on the surface morphology of TiO_2-SiO_2, chitosan in Figure 2. Chitosan was instrumental in steering nanoporous printed and crystal growth, while the surfactant SDS will distribute porosity on the surface so evently and homogenous. From the analysis of Size Particles Analyzer (PSA) showed the particles size distributed nanoporous the average size at 50 μm.

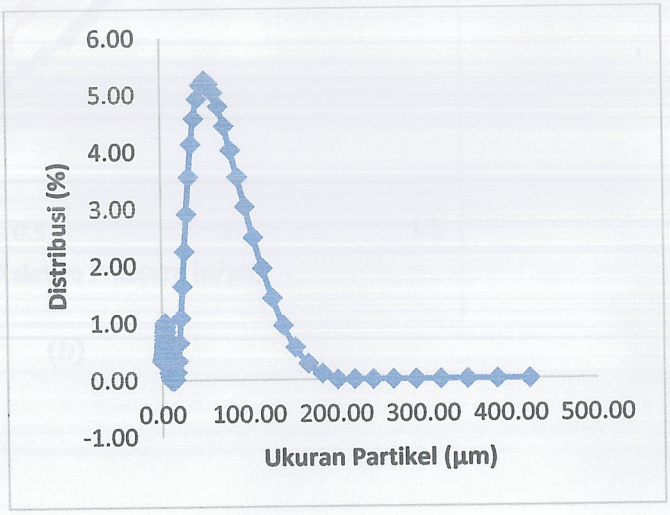
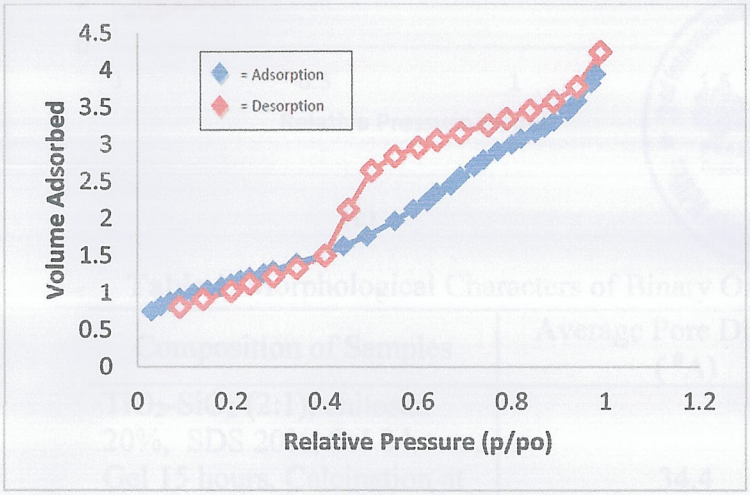
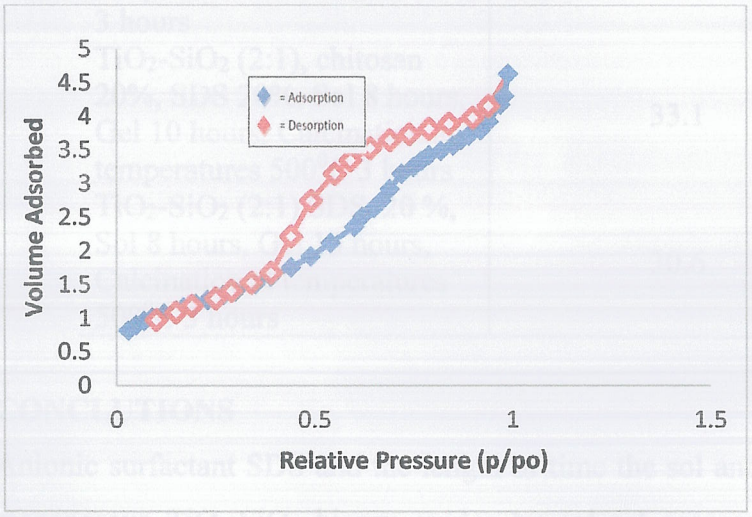


Fig 3. Particles Size Analysis of TiO_2-SiO_2 (2:1), chitosan 20%, SDS 20% Based on The Analysis of PSA

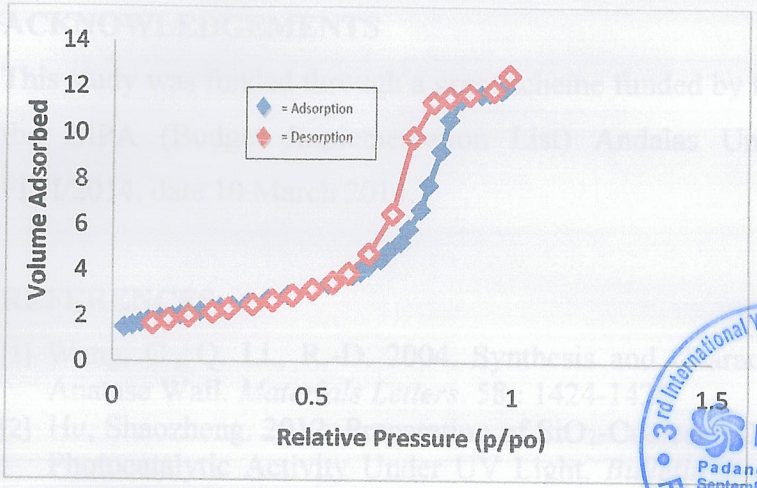
The pattern mesoporous of particles showed from the analysis of BET/BJH curve for binary oxides TiO_2-SiO_2 photocatalyst on varied composition is the same. Specific surface area affected by curing gel time with the presence of chitosan and SDS concentration provide increased surface area. Mean while the larger pore diameter and event distributed when the addition of the anionic surfactant SDS at a concentration of 20%.



(a)



(b)



(c)

Table 1. Morphological Characters of Binary Oxides TiO_2-SiO_2 Photocatalyst

Composition of Samples	Average Pore Diameter (^{0}A)	Surface **Area** (m^2/g)
TiO_2-SiO_2 (2:1), chitosan 20%, SDS 20%, Sol 8 hours, Gel 15 hours, Calcination at temperatures at 500^{0}C 3 hours	34.4	282.2
TiO_2-SiO_2 (2:1), chitosan 20%, SDS 20%, Sol 8 hours, Gel 10 hours, Calcination at temperatures 500^{0}C 3 hours	33.1	113.2
TiO_2-SiO_2 (2:1) SDS 20 %, Sol 8 hours, Gel 15 hours, Calcination at temperatures 500^{0}C 3 hours	30.6	101.2

CONCLUTIONS

Anionic surfactant SDS and the length of time the sol and gel affects condition of formation of mesoporous TiO_2-SiO_2 binary oxides by sol-gel process. The rough and porous surfaces of samples were prepared of SDS 20% of precursor. The BET specific surface area of the samples changed from 101.2 to 282.2 m^2g^{-1} for a sol time of 8 hours, calcination temperatures at 500^{0}C during 3 hours with varied durations and gel process was 15 hours, moreover, the average porous size 34.4 to 30.6 Å.

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