



FORMULATING A NOVEL FLUORINATED SILICA NANOPARTICLE USING FLUOROALKYLSILANE AS A WETTABILITY ALTERATION AGENT

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ABSTRACT

A novel fluorinated silica nanoparticles were synthesized using 1H,1H,2H,2H-perfluorodecyltriethoxysilane (FAS17) and further characterized to evaluate the wettability alteration capability. Previous research (1, 2) has utilized fluoroalkanoic acids as the coating agent. First, the in-situ functionalization method employs tetraethoxysilane (TEOS) as the silica precursor and water-soluble amine as the catalyst. It is then further functionalized with 1H,1H,2H,2H-perfluorodecyltriethoxysilane (FAS17) with ethanol to attain the novel fluorinated silica nanoparticles. The preliminary characterization from FTIR analysis indicated that the in-situ functionalization was successfully applied. The new bonding formation with fluorine attachment on the novel fluorinated silica nanoparticles is capable to alter the wettability of the solid surface, exhibiting self-cleaning properties.

Keywords: *Fluorinated Silica Nanoparticles, Fluoroalkylsilane, Wettability Alteration, Functionalization*

RESEARCH HIGHLIGHTS

1. A novel fluorinated silica nanoparticles is successfully functionalized with fluoroalkylsilane (1H, 1H, 2H, 2H-perfluorodecyltriethoxysilane).
2. FTIR analysis confirmed the new chemical bonding formation.

Research Objectives

The objective of this research is to formulate novel fluorinated silica nanoparticles from fluoroalkylsilane, specifically 1H, 1H, 2H, 2H-perfluorodecyltriethoxysilane in order to create a superhydrophobic and oleophobic surface with self-cleaning properties.

Methodology

Stöber process (3) is selected to prepare the silica nanoparticles. Tetraethoxysilane (TEOS), ammonium hydroxide solution (NH₄OH), ethanol (C₂H₆O) and 1H,1H,2H,2H-Perfluorodecyltriethoxysilane (FAS17) were purchased from Sigma-Aldrich (M) Sdn. Bhd.

The synthesis procedure was as followed (4). 5 ml of TEOS together with FAS17 in different ratios were dissolved in 12.5 ml ethanol in a 50 ml beaker. Meanwhile, 6.5 ml of ammonium hydroxide, 25% NH₄OH was mixed in 12.5 ml ethanol in another 50 ml beaker. Then, FAS17/TEOS mixture from the first beaker was added into NH₄OH mixture (NH₄OH/TEOS molar ratio of 6.66:1) in the second beaker and stirred at room temperature for 24 hours. The solution was then ultrasonicated for 30 minutes. Nanoparticles of different sizes were produced by changing the ratio of FAS17 to TEOS.

Results

The main indicator of a new chemical bonding Si-O-C is at peak 1093 to 1077 cm⁻¹ which shows the link between FAS17 molecules and nanosilica. Other important peaks are at 1208

and 1150 cm^{-1} which indicated the C-F bonds from fluoroalkylsilane are now formed on the surface of nanoparticles (4, 5).

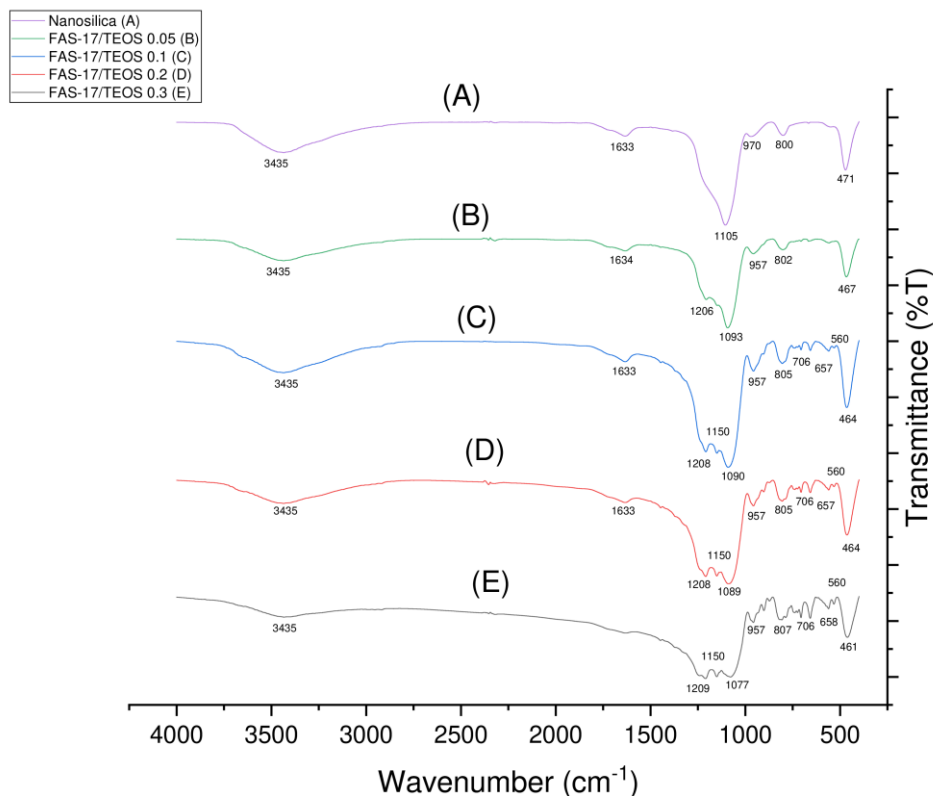


Fig. 1. FTIR spectra of (A) pure nanosilica, and fluorinated silica nanoparticles with different molar ratio of FAS17/TEOS: (B) 0.05; (C) 0.10; (D) 0.20; (E) 0.30.

Findings

FTIR analysis showed several new bondings have formed especially Si-O-C and CF bonds on the novel fluorinated silica nanoparticles. This indicated that the functionalization of the nanoparticles was successful.

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