

# Synthesis and Characterization of ETS-10 Based on Precursors of $[\text{Ti}_8\text{O}_{12}(\text{H}_2\text{O})_{24}]\cdot\text{Cl}_8\cdot 7\text{H}_2\text{O}\cdot\text{HCl}$ as Titanium Source

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## ABSTRACT

Since the discovery of TS-1 (Titano Silicate-1), a very good catalyst for various selective oxidation reactions with  $\text{H}_2\text{O}_2$  as oxidants, titanium has been incorporated or doped into the framework of zeolite and mesoporous materials. Titanium in all these materials has tetrahedral and oxygen ( $\text{TiO}_4$ ) coordination. Furthermore it has been found a new family of micropore silicates that have a skeleton Ti(IV) in the form of octahedral coordination with oxygen ( $\text{TiO}_6$ ) known as ETS (Engelhard Titanium Silicate). Some of the interesting ETS are structural and functional in terms of ETS-10. The ETS-10 material has a unique molecular architecture because the titanium skeletal matrix has octahedral coordination with oxygen ( $\text{TiO}_6$ ). ETS-10 has been successfully synthesized using several titanium source precursors, for example:  $\text{TiCl}_4$ ,  $\text{TiO}_2$ -anatase, tetra ethyl ortho titanate (TEOT),  $\text{TiCl}_3$ . A new precursor to the source of titanium has been found lately, namely titanium-oxo-oxides titanium with the molecular formula of  $[\text{Ti}_8\text{O}_{12}(\text{H}_2\text{O})_{24}]\cdot\text{Cl}_8\cdot\text{HCl}\cdot 7\text{H}_2\text{O}$ . The structure of  $[\text{Ti}_8\text{O}_{12}(\text{H}_2\text{O})_{24}]\cdot\text{Cl}_8\cdot\text{HCl}\cdot 7\text{H}_2\text{O}$  is composed of octameric clusters  $[\text{Ti}_8\text{O}_{12}(\text{H}_2\text{O})_{24}]^{8+}$  which are connected to each other through hydrogen bonds from water molecules. Chloride anions are located between octameric cations to balance the charge. The octameric cation structure is a cluster with pseudo cubic symmetry composed of 8 octahedral  $[\text{TiO}_3(\text{H}_2\text{O})_3]^{2+}$  which is connected to three neighboring peaks through oxo to form an structural type of  $\text{ReO}_3$  octameric structure. These compounds are soluble in water, acetone and alcohol, whereas in high concentrated water they are easily condensed. Based on the foregoing, this study aims to synthesize ETS-10 using the precursor  $[\text{Ti}_8\text{O}_{12}(\text{H}_2\text{O})_{24}]\cdot\text{Cl}_8\cdot\text{HCl}\cdot 7\text{H}_2\text{O}$  as a titanium source by hydrothermal method and precipitation with reflux technique and its application as a catalyst or photocatalyst in a selective oxidation reaction with  $\text{H}_2\text{O}_2$  and epoxidation. ETS-10 synthesis was carried out through various application of variable variations, namely the ratio of moles of synthesis reactants. Products produced by ETS-10 (major) and ETS-4 (minor)

Kata Kunci: *ETS-10, titanium silicate, zeolite, micropore*