Characterization and evaluation of photocatalytic activity of strontium titanate photocatalysts prepared by different synthesis methods

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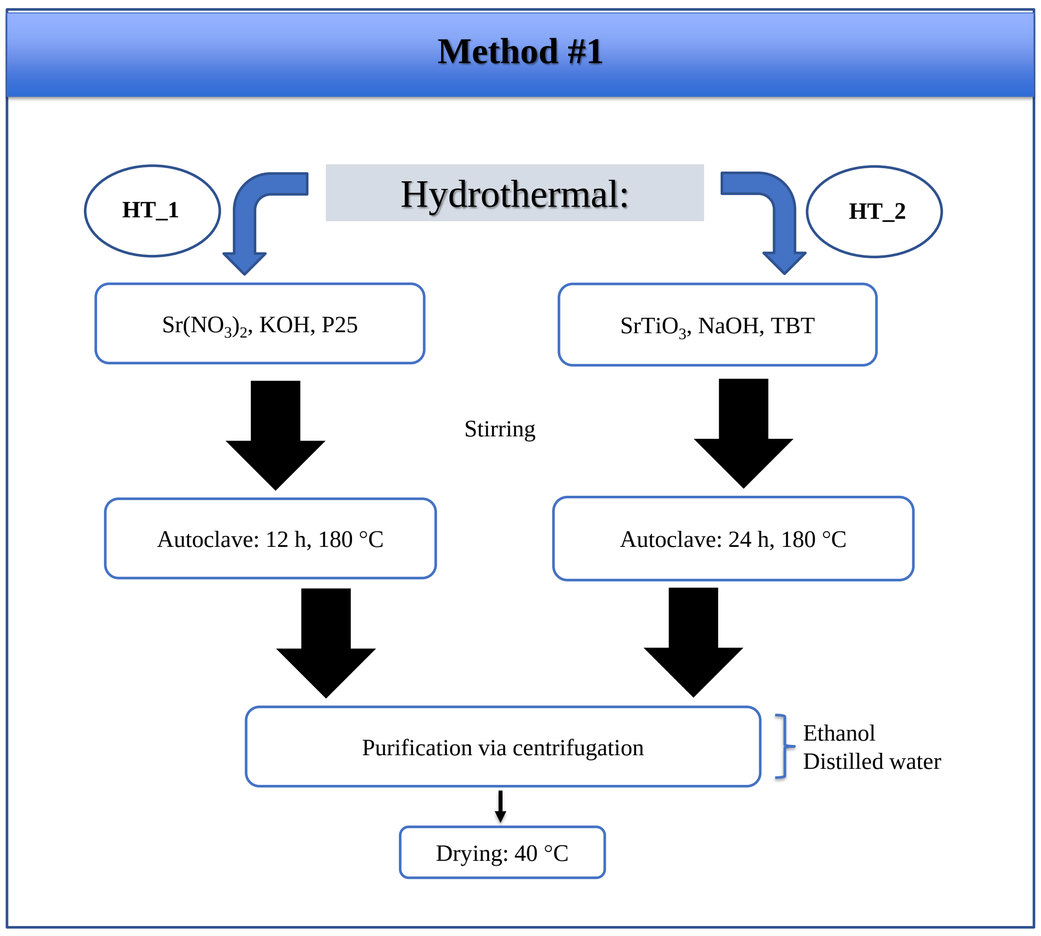
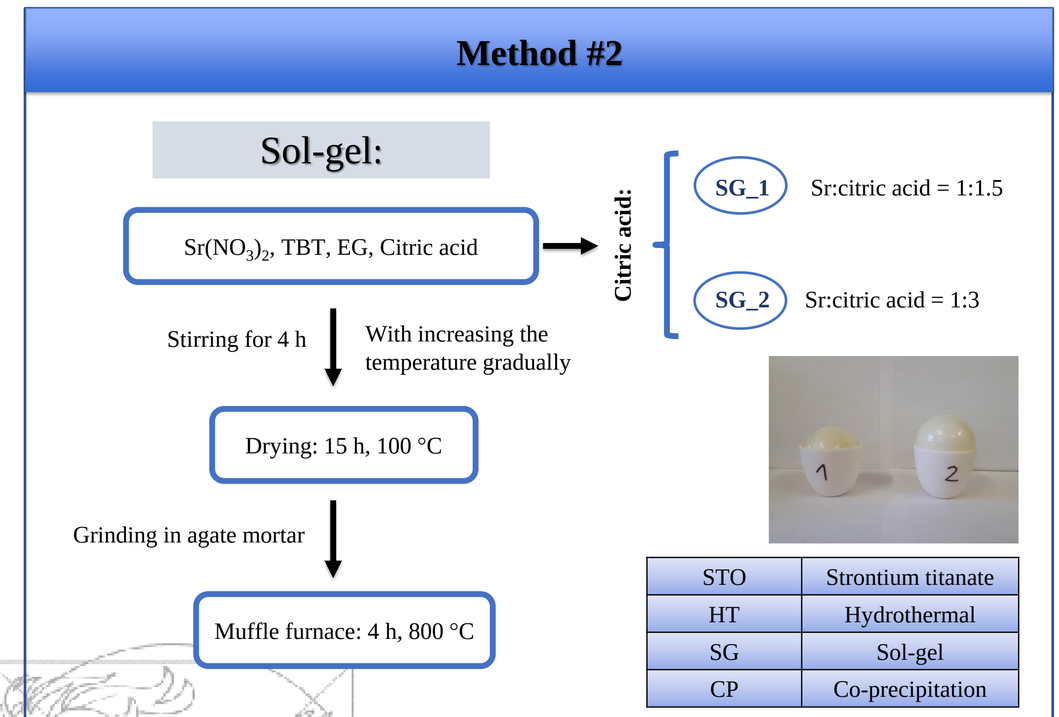
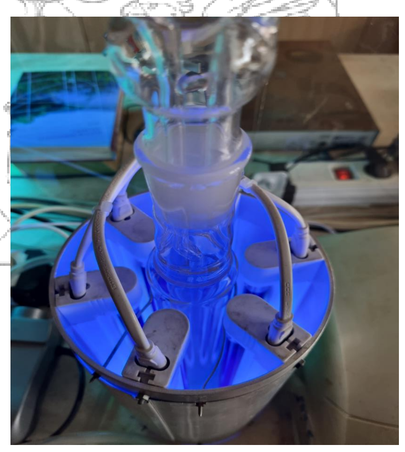
Introduction

Photocatalytic oxidation is a promising method to treat a wide variety of environmental pollutants. Alkaline earth metal titanates are excellent photocatalysts for mineralizing a wide range of organic pollutants. Strontium titanate nanoparticles have attracted much attention due to their physical and chemical properties. $SrTiO_3$ photocatalysts were synthesized by sol-gel, hydrothermal, and co-precipitation methods. The structural and optical properties and photocatalytic activity of the samples were studied to identify the most efficient sample. Finally, this sample was subjected to rapid heat treatment (RHT) with short (5 °C/min), and long (60 °C/min) exposures to investigate the effect of calcination.

Synthesis







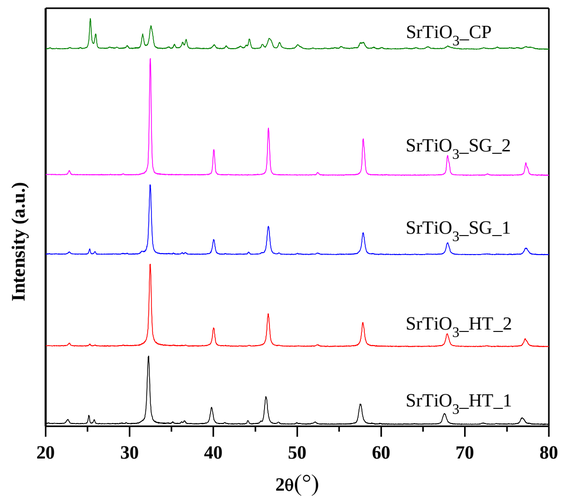
The photooxidation activity of the samples was evaluated by using phenol (c = 0.1 mM), and oxalic acid (c = 1 mM).

The photocatalytic experiments were carried out under UV light (λ_{max} = 365 nm) in a double-walled glass vessel (thermostated to 25 °C).

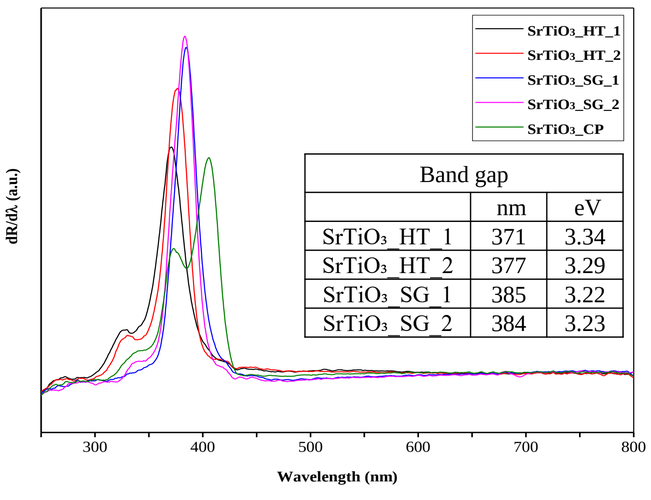
Characterization and photocatalytic activity

The structural and optical properties of the samples were studied by X-ray diffraction (XRD) and diffuse reflectance spectroscopy (DRS). Band gap values were obtained from the first-order derivative of the DR spectra. Phenol was used as a model pollutant to investigate photocatalytic activity; however, in some cases, oxalic acid was applied as well.

XRD

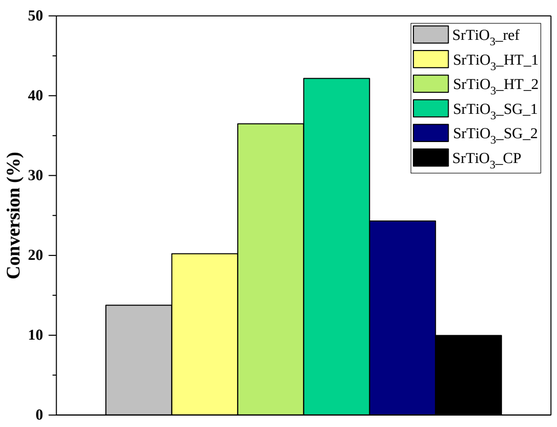


DRS

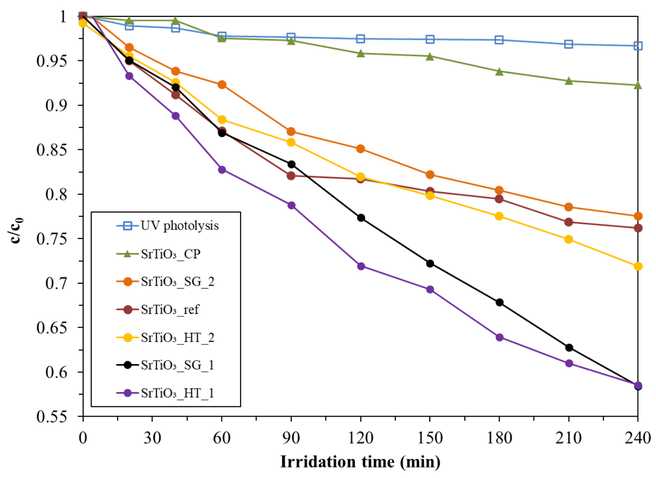


Band gap		
	nm	eV
$SrTiO_3$_HT_1	371	3.34
$SrTiO_3$_HT_2	377	3.29
$SrTiO_3$_SG_1	385	3.22
$SrTiO_3$_SG_2	384	3.23

Photocatalytic activity

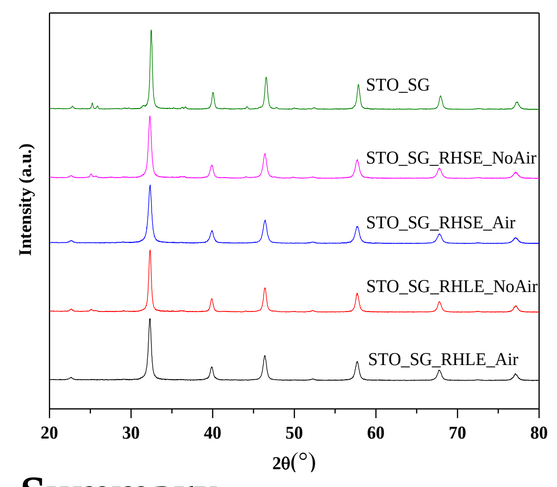


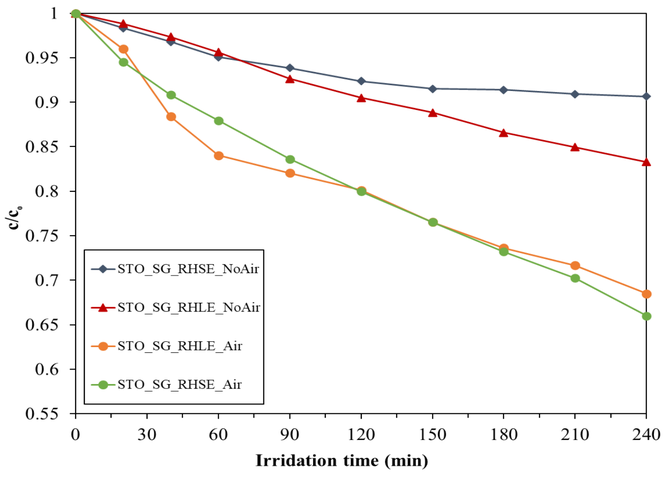
Oxalic acid conversion



Phenol degradation curve

Characterization and photocatalytic activity of RHT samlpes





Summary

- Strontium titanate photocatalyst were synthesized via different methods
- XRD: SG and HT synthesis resulted in pure $SrTiO_3$
- DRS: $SrTiO_3$_SG_1 had the narrowest band gap and overall, the best photocatalytic activity (phenol, oxalic acid)
- Calcination conditions (exposure time, air introduction) were investigated
- STO_SG_RHSE_Air proved to be the best based on phenol degradation experiments

Acknowledgements

This study was financed by the 2019-2.1.13-TÉT_IN-2020-00015 project. T. Gyulavári is grateful for the financial support of the NKFI-PD-138248 project. Zs. Pap acknowledges the Bolyai János scholarship provided by the Hungarian Academy of Sciences.