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# P-type transparent LaCuOS semiconductor synthesized via a novel two-step solid state reaction and sulfurization process

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## Abstract

A novel and simple two-step preparation method has been successfully developed to synthesize high quality oxychalcogenide LaCuOS, a direct-gap p-type transparent semiconductor. We first successfully synthesized CuLaO<sub>2</sub> using cheap Cu<sub>2</sub>O and La<sub>2</sub>O<sub>3</sub> via solid state reaction, and then achieved high quality LaCuOS through sulfurization at an optimum temperature of 860°C without using conventional hazardous H<sub>2</sub>S or CS<sub>2</sub> gas. With the use of easily available and relatively more stable starting materials of Cu<sub>2</sub>O, La<sub>2</sub>O<sub>3</sub> and S, this method is less costly than conventional solid state reaction route for obtaining oxychalcogenides. The synthesized LaCuOS of high purity has a band gap of 3.1eV and gives a resistivity of 0.25MΩ.cm and high seebeck coefficient of +515μV/K. Moreover, it demonstrates strong luminescence at room temperature. The success of this novel two-step synthesis method also opens a door for environmental friendly synthesis of other high performance oxychalcogenides.

## Keywords

P-type TCO; oxychalcogenide; transparent semiconductor; sulfurization; LaCuOS

## 1. Introduction

Optoelectronics is one of the most important electronics in our daily life. Transparent semiconductor oxides (TSOs) play a crucial role in optoelectronics. Over the past few decades,

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