CuI/VO_2(M) Composites for Enhanced Thermoelectric Performance

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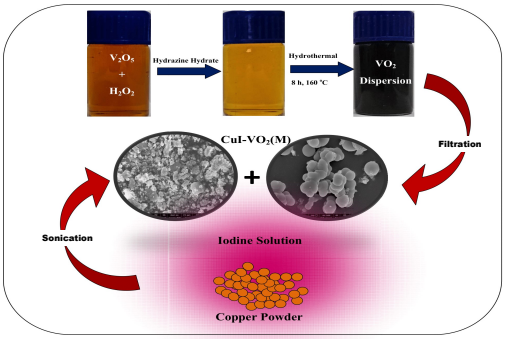
Abstract

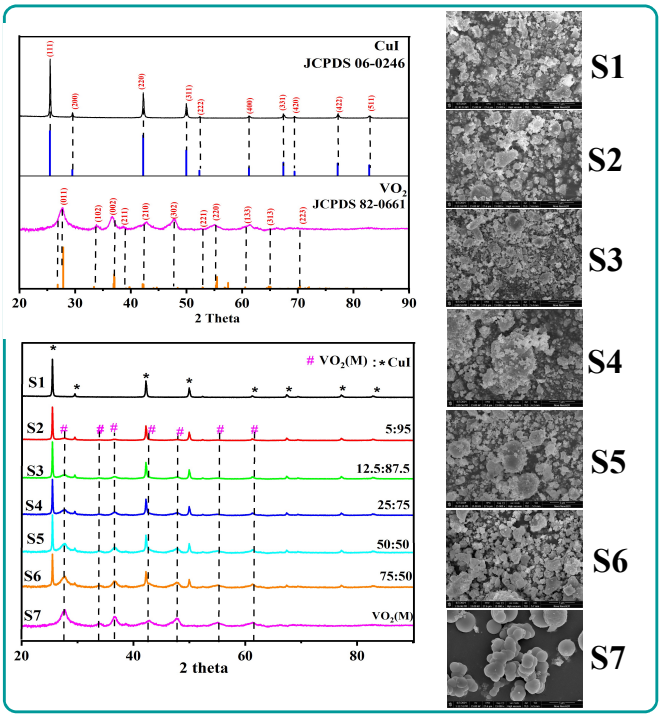
A hydrothermal approach and a simple synthetic method have been used to synthesize bulk VO_2(M) material and bulk CuI, respectively. A composite material is created using a motar mechanical grinding tool. CuI has a high Seebeck coefficient and conductivity, achieving a room temperature thermoelectric power factor of around 52.9 $\mu Wm^{-1}K^{-2}$, VO_2(M) has a low power factor due to its low electrical conductivity and Seebeck coefficient. Mixing and heat annealing the materials have improved the thermoelectric performance, with annealing at moderate temperatures enhancing the composite's power factor to 256.3$\mu Wm^{-1}K^{-2}$ at ambient temperature.. The detailed XRD analysis of the samples also supports the formation of Composite in varied proprtions. SEM measurements also support the data with visible particles of the composite materials.



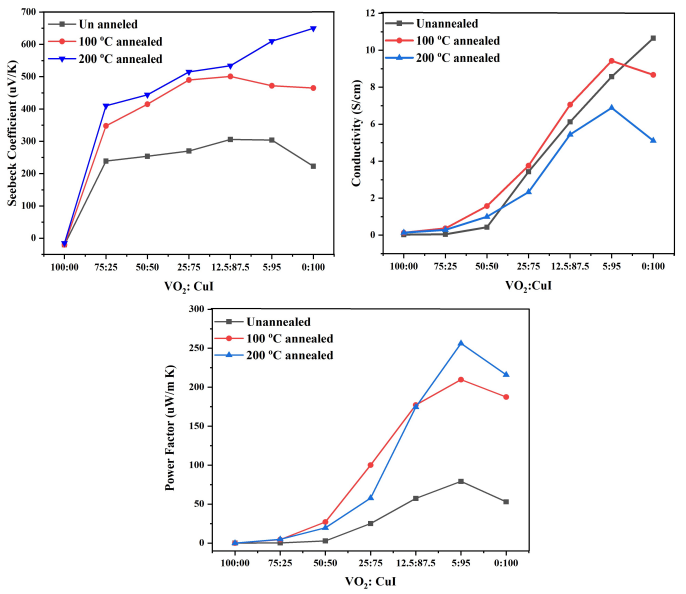
Introduction

Thermoelectric materials are a category of electronic materials that have the ability to transform differences in temperature into electrical power. Current commercial thermoelectric materials commonly contain elements such as Pb, Bi, and Te, which raise significant concerns about environmental pollution. Hence, it is imperative to utilize materials that are less hazardous and readily available in order to advance the development of thermoelectric generators and expand their range of applications. CuI is a thermoelectric material that is known to have power factor of approximately ~70 $\mu Wm^{-1}K^{-2}$, which can be enhanced through moderate temperature annealing. This annealing process reduces the electrical conductivity of CuI, resulting in a power factor of around ~160 $\mu Wm^{-1}K^{-2}$. On annealing, the VO_2(M) demonstrates an enhancement in electrical conductivity. Here, we aim to investigate the thermoelectric properties of a CuI/VO_2(M) composite with different proportions in order to enhance the overall power factor values.

Characterization



Results



Conclusions

CuI/VO_2(M) composites are prepared with uniform mixing of both synthesized constituent materials in various weight proportions.

XRD confirms the formation of composite with visible peaks of both VO_2(M)) and CuI with proportional intensities of the individual constituent materials. Further SEM images also visibly shows the formation of composite.

The Seebeck coefficient enhanced and electrical conductivity diminished with annealing at 200 °C for pure CuI. It was countered by the increasing conductivity of VO_2(M) to restrict the fall of electrical conductivity

The sample with 5% VO_2(M)) has shown Seebeck Coefficient ~ 610 µV/K with electrical conductivity ~ 6.88 S/cm to result the power factor value of ~ 256 $\mu Wm^{-1}K^{-2}$

References

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