

**PENGARUH MASSA CuCl₂ YANG DITAMBAHKAN DALAM SINTESIS Ti₃C₂
MENGGUNAKAN METODE *MOLTEN SALT-SHIELDED SYNTHESIS (MS3)*
TERHADAP KARAKTERISTIK MATERIAL**

SKRIPSI

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains
Program Studi Fisika Kelompok Bidang Kajian Fisika Material



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(Skripsi ini merupakan bagian dari payung penelitian Prof. Dr. Lilik Hasanah,
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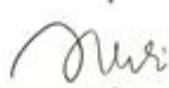
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ADI GUNAWAN

Pengaruh Massa CuCl₂ yang Ditambahkan dalam Sintesis Ti₃C₂ Menggunakan Metode *Molten Salt-Shielded Synthesis* (MS3) Terhadap Karakteristik Material.

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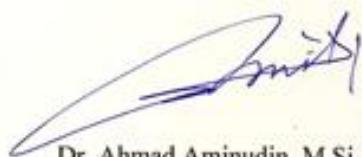
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ABSTRAK

Ti₃C₂ merupakan salah satu material MXene, yaitu material dua dimensi (2D) yang memiliki konduktivitas listrik tinggi serta potensi aplikasi luas dalam berbagai bidang, seperti sensor, elektroda superkapasitor, dan pelindung elektromagnetik. Namun, tantangan terkait sintesis Ti₃C₂ yang aman dan ramah lingkungan tanpa menggunakan asam fluorida (HF) masih menjadi perhatian utama. Penelitian ini bertujuan untuk mensintesis Ti₃C₂ menggunakan metode *Molten Salt-Shielded Synthesis* (MS3) dengan variasi massa CuCl₂, serta mengevaluasi pengaruhnya terhadap struktur kristal, morfologi, dan konduktivitas listrik dari Ti₃C₂ yang dihasilkan. Metode MS3 dipilih karena menawarkan keunggulan berupa prosedur yang lebih aman, tanpa bahan korosif berbahaya, serta memungkinkan kontrol sintesis yang lebih baik dibandingkan metode konvensional. Karakterisasi dilakukan menggunakan *X-ray Diffraction* (XRD) untuk analisis struktur kristal, *Scanning Electron Microscopy* (SEM) untuk morfologi, *Fourier Transform Infrared Spectroscopy* (FTIR) untuk identifikasi gugus fungsi, serta uji konduktivitas listrik. Hasil XRD menunjukkan bahwa variasi massa 4,146 gram CuCl₂ menghasilkan Ti₃C₂ dengan kristalinitas tertinggi, ditandai oleh pergeseran puncak indeks Miller (002) dan hilangnya puncak aluminium. SEM menunjukkan morfologi berlapis menyerupai akordeon dengan ketebalan rata-rata 112,585 nm. Nilai konduktivitas tertinggi sebesar 278,08 S/cm diperoleh pada variasi massa CuCl₂ 4,146 gram dengan lama 1 hari penyimpanan. Uji stabilitas menunjukkan bahwa konduktivitas menurun seiring waktu akibat oksidasi. Secara keseluruhan, metode MS3 dengan variasi massa CuCl₂ terbukti efektif menghasilkan Ti₃C₂ dengan struktur dan konduktivitas yang unggul, sekaligus menawarkan pendekatan sintesis yang lebih aman, efisien, dan berkelanjutan dibandingkan metode berbasis HF.

Kata Kunci : Ti₃C₂, MS3, CuCl₂, Sintesis, Karakterisasi

ABSTRACT

Ti₃C₂ is one of the MXene materials, a two-dimensional (2D) material that has high electrical conductivity and wide application potential in various fields, such as sensors, supercapacitor electrodes, and electromagnetic shielding. However, challenges related to the safe and environmentally friendly synthesis of Ti₃C₂ without using hydrofluoric acid (HF) are still a major concern. This study aims to synthesize Ti₃C₂ using the Molten Salt-Shielded Synthesis (MS3) method with variations in CuCl₂ mass, and evaluate its effect on the crystal structure, morphology, and electrical conductivity of the resulting Ti₃C₂. The MS3 method was chosen because it offers the advantages of a safer procedure, without harmful corrosive materials, and allows better control of the synthesis compared to conventional methods. Characterization was performed using X-ray Diffraction (XRD) for crystal structure analysis, Scanning Electron Microscopy (SEM) for morphology, Fourier Transform Infrared Spectroscopy (FTIR) for functional group identification, and electrical conductivity test. XRD results show that the mass variation of 4.146 grams of CuCl₂ produces Ti₃C₂ with the highest crystallinity, characterized by a shift in the Miller index peak (002) and the disappearance of the aluminum peak. SEM shows an accordion-like layered morphology with an average thickness of 112.585 nm. The highest conductivity value of 278.08 S/cm was obtained in the CuCl₂ mass variation of 4.146 grams with a duration of 1 day of storage. The stability test showed that the conductivity decreased over time due to oxidation. Overall, the MS3 method with CuCl₂ mass variation proved effective in producing Ti₃C₂ with superior structure and conductivity, while offering a safer, more efficient, and sustainable synthesis approach compared to HF-based methods.

Keywords: Ti₃C₂, MS3, CuCl₂, Synthesis, Characterization.

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