

**PENGARUH PENAMBAHAN *TETRAKIS-(4-CARBOXYPHENYL)-PORPHYRIN* TERHADAP SIFAT  
FISIKOKIMIA ZIF BERBASIS  $\text{Cu}(\text{2-METILIMIDAZOL})_2$**

**SKRIPSI**

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains  
Program Studi Kimia



oleh

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UNIVERSITAS PENDIDIKAN INDONESIA  
BANDUNG  
2022**

## LEMBAR HAK CIPTA

### **PENGARUH PENAMBAHAN *TETRAKIS-(4-CARBOXYPHENYL)- PORPHYRIN* TERHADAP SIFAT FISIKOKIMIA ZIF BERBASIS $\text{Cu(2- METILIMIDAZOL)}_2$**

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Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

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**PENGARUH PENAMBAHAN *TETRAKIS-(4-CARBOXYPHENYL)-  
PORPHYRIN* TERHADAP SIFAT FISIKOKIMIA ZIF BERBASIS  $\text{Cu(2-  
METILIMIDAZOL)}_2$**

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## LEMBAR PERNYATAAN

Dengan ini saya menyatakan bahwa skripsi dengan judul “**PENGARUH PENAMBAHAN *TETRAKIS-(4-CARBOXYPHENYL)-PORPHYRIN* TERHADAP SIFAT FISIKOKIMIA ZIF BERBASIS Cu(2-METILIMIDAZOL)<sub>2</sub>**” ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu yang berlaku dalam masyarakat keilmuan. Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila di kemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

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Yang Membuat Pernyataan,

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## KATA PENGANTAR

Puji dan syukur penulis panjatkan kepada Allah SWT, atas segala rahmat dan karunia-Nya, penulis dapat menyelesaikan skripsi dengan judul “**PENGARUH PENAMBAHAN *TETRAKIS-(4-CARBOXYPHENYL)-PORPHYRIN* TERHADAP SIFAT FISIKOKIMIA ZIF BERBASIS Cu(2-METILIMIDAZOL)<sub>2</sub>**” ini sesuai waktu yang ditentukan.

Skripsi yang disusun untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains Program Studi Kimia, Departemen Pendidikan Kimia, Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam, Universitas Pendidikan Indonesia.

Pada penulisan skripsi ini, penulis sangat menyadari terdapat banyak kekurangan dan kesalahan, baik segi materi maupun penjelasan yang jauh dari kata sempurna. Oleh karena itu, penulis sangat terbuka dan sangat mengharapkan kritik dan masukan sebagai perbaikan kedepannya. Akhir kata penulis berharap semoga skripsi ini dapat memberikan manfaat dan menambahkan wawasan bagi pembaca dan khususnya bagi penulis.

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## ABSTRAK

*Zeolitic Imidazole Framework* (ZIF) merupakan salah satu sub kelas *Metal organic framework* (MOF) yang memiliki sifat yang mudah untuk dimodifikasi. Sifat fisikokimia ZIF dapat ditingkatkan dengan melakukan modifikasi *linker* organik pada kerangka ZIF. Penelitian ini bertujuan untuk mengetahui pengaruh penambahan *tetrakis-(4-carboxyphenyl)-phorphyrin* (TCPP) terhadap sifat fisikokimia ZIF berbasis Cu-2-metilimidazol ( $\text{Cu(mim)}_2$ ).  $\text{Cu(mim)}_2$  disintesis dan dimodifikasi dengan mereaksikan garam logam tembaga nitrat, 2-metilimidazol, dan TCPP (5:9,5:0,1 mmol) menggunakan metode hidrothermal. Hasil sintesis dan modifikasi  $\text{Cu(mim)}_2$  dianalisis sifat fisikokimia berdasarkan *X-Ray Diffraction* (XRD), spektra *Fourier Transform Infrared* (FTIR), *Thermal Gravimetric Analysis* (TG/DTA), dan adsorpsi nitrogen. Hasil penelitian menunjukkan bahwa  $\text{Cu(mim)}_2$  dan  $\text{Cu(mim)}_2/\text{TCPP}$  memiliki pola difraksi sinar-X yang karakteristik pada  $2\theta$   $38,6^\circ$  dan  $38,5^\circ$ . Penambahan TCPP menyebabkan penurunan kristalinitas  $\text{Cu(mim)}_2$  dari 38,97% menjadi 36,10%. Interaksi antara Cu dan TCPP ditunjukkan oleh spektra FTIR pada panjang gelombang  $1421\text{ cm}^{-1}$  yang mengindikasikan ikatan O-CO-Cu. Pada uji stabilitas termal,  $\text{Cu(mim)}_2$  dan  $\text{Cu(mim)}_2/\text{TCPP}$  menunjukkan kestabilan tinggi yaitu hingga suhu  $850^\circ\text{C}$ . Selain itu, penambahan TCPP terhadap  $\text{Cu(mim)}_2$  dapat meningkatkan luas permukaan spesifik BET dari  $2,837\text{ m}^2/\text{g}$  menjadi  $33,448\text{ m}^2/\text{g}$ .

Kata kunci:  $\text{Cu(mim)}_2$ ,  $\text{Cu(mim)}_2/\text{TCPP}$ , modifikasi ZIF.



## ABSTRACT

*Zeolitic Imidazole Framework (ZIF) is one of the subclasses of Metal Organic Framework (MOF) which has properties that are easy to modify. The physicochemical properties of ZIF can be improved by modifying the organic linker on the ZIF framework. This study aimed to determine the effect of addition of tetrakis-(4-carboxyphenyl)-phorphyrin (TCPP) on the physicochemical properties of Cu-2-methylimidazole ( $\text{Cu}(\text{mim})_2$ ) based ZIF.  $\text{Cu}(\text{mim})_2$  was synthesized and modified by reacting the metal salt of copper nitrate, 2-methylimidazole, and TCPP (5 : 9,5 : 0,1 mmol) using the hydrothermal method. The results of the synthesis and modification of  $\text{Cu}(\text{mim})_2$  were analyzed for physicochemical properties based on X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR) spectra, Thermal Gravimetric Analysis (TG/DTA), and nitrogen adsorption. The results showed that  $\text{Cu}(\text{mim})_2$  and  $\text{Cu}(\text{mim})_2/\text{TCPP}$  had characteristic X-ray diffraction patterns at  $2\theta$   $38.6^\circ$  and  $38.5^\circ$ . The addition of TCPP caused a decrease in the crystallinity of  $\text{Cu}(\text{mim})_2$  from 38.97% to 36.10%. The interaction between Cu and TCPP was shown by FTIR spectra at a wavelength of  $1421\text{ cm}^{-1}$  which indicated the O-CO-Cu bond. In the thermal stability test,  $\text{Cu}(\text{mim})_2$  and  $\text{Cu}(\text{mim})_2/\text{TCPP}$  showed high stability up to a temperature of  $850^\circ\text{C}$ . Furthermore, the addition of TCPP to  $\text{Cu}(\text{mim})_2$  can increase the specific surface area of BET from  $2,837\text{ m}^2/\text{g}$  to  $33,448\text{ m}^2/\text{g}$ .*

*Keyword:  $\text{Cu}(\text{mim})_2$ ,  $\text{Cu}(\text{mim})_2/\text{TCPP}$ , modificatioin, ZIF.*

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