Decomposition of an Energetic Ionic Liquid over Mesoporous CuO Catalyst

Sujeong Heo[1], Bo Kyeong Jeon[2], Chengbin Li[2], Ji Man Kim[2], Young Min Jo[3] and Jong-Ki Jeon[1*]

[1]*Department of Chemical Engineering, Kongju National University, Cheonan, Korea*

[2]*Department of Chemistry, Sungkyunkwan University, Suwon, Korea*

[3]*Department of Environmental Science and Engineering, Kyung Hee University, Yongin, Korea*

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*E-mail: jkjeon@kongju.ac.kr

Hydrazine is the most commonly used material as a propellant. However, recently, due to the toxicity of hydrazine, research on alternative substances has been actively underway [1]. One of the most promising green compounds is ammonium dinitramide (ADN, $NH_4N(NO_2)_2$). It does not lead to a halogen acid decomposition product. Also it is a very strong oxidant and has great potential. These features make it suitable for ammunition, explosives and especially for rocket propellants [2-3]. So, an ADN-based liquid monopropellant, containing ADN, water and a fuel, is promising substitute for hydrazine [4]. Despite the many advantages, there is a problem that ignition of an ADN-based liquid monopropellant is very difficult because of the high water content. Therefore, ADN-based monopropellants should be ignited by the catalyst decomposition method rather than the general ignition method [5]. In this present work, the catalyst decomposition of an ADN-based liquid monopropellant was performed over CuO metal oxides prepared by a nano-replication method and a co-precipitation method. And we studied the relationship between the catalytic performance capabilities and the physico-chemical properties of mesoporous metal oxides by various characterization techniques.

Mesoporous CuO (meso-CuO) catalyst was prepared by a nano-replication method. It is a manufacturing method of catalyst having a regular pore size distribution and a high surface area, using a mesoporous silica as a template material [6]. N_2 adsorption-desorption isotherm and XRD patterns indicate that the meso-CuO catalyst was successfully synthesized. Conventional CuO catalyst was prepared by the co-precipitation method and also successfully synthesized. The meso-CuO catalyst, prepared by nano-replication method, showed better catalytic performance during the catalytic decomposition of an ADN-based liquid monopropellant compared to the CuO catalyst prepared by the co-precipitation method.

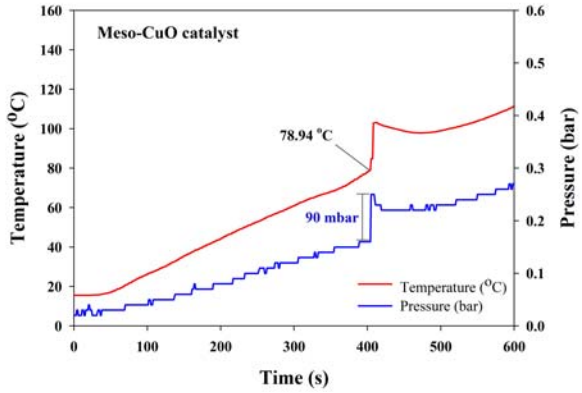

Fig. 1 Catalytic decomposition of ADN-based monopropellant over the meso-CuO catalyst in a constant volume reactor.

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REFERENCES

[1] R. Eloiridi, S. Rossignol, C. Kappenstein and D. Duprez, AIAA Journal, 19 (2003) 213

[2] R. Amrousse, K. Fujisato, H. Habu, A. Bachar, C. Folet-Houttemane and K. Hori, Catal. Sci. Technol., 3 (2013) 2614.

[3] J. Kleimark, R. Delanoë, A. Demairé and T. Brinck, Theor. Chem. Acc., 132 (2013) 1412.

[4] R. Amrousse, K. Fujisato, H. Habu, A. Bachar, C. Follet-Houttemane and K. Hori, Catal. Sci. Technol., 10 (2013) 2614.

[5] L. Courthéoux, D. Amariei, S. Rossignol and C. Kappenstein, Appl. Catal. B: Environ., 62 (2006) 217.

[6] G. Kim, J. Kim, C.-H. Lee, J. Han, B.-H. Jeong and J.-K. Jeon, J. Nanosci. Nanotechnol., 16 (2016) 9153.