ZnO가 함침된 UV 차단 화장품 신소재 일라이트 복합분체의 합성 및 특성 연구

김명훈*, 김선남[1], 장석홍[2], 송윤구[3], 김광수[4], 이수덕[5]

*캠브리지대학교 화학과, [1]나드리화장품㈜ 기술연구소, [2]연세대학교 자연과학기술연구소, [3]연세대학교 지구시스템과학과, [4]㈜에이티랩, [5]㈜용궁일라이트
(mhk22@cam.ac.uk, myunghunkim@ymail.com*)

The study of synthesis and characterisation about ZnO loaded illites as the new cosmetic composite materials for UV protection

Myung Hun Kim*, Seon Nam Kim[1], Seok-Heung Jang[2], Yungoo Song[3], Kwangsoo Kim[4], Sudok Yi[5]

*Department of Chemisty, University of Cambridge, Cambridge, CB2 1EW, UK
[1]Technology Institute, The Nadree Co. Ltd., Pyongtaik-Si, 451-863, Korea
[2]Natural Science Research Institute, Yonsei University, Seoul, 120-749, Korea
[3]Department of Earth System Sciences, Yonsei University, Seoul, 120-749, Korea
[4]AT LAB Co. Ltd., SNU Business Incubator#5-105, Suwon-Si, 441-853 KOREA
[5]Yong Koong Illite Co. Ltd., Seoul 152-080, Korea
(mhk22@cam.ac.uk, myunghunkim@ymail.com*)

Illite clays, due to their wide distribution and colloidal properties, play an important role in the mobility and bioavailability of nutrients and pollutants in soils and waters. Illite clays are interlayer-deficient dioctahedral minerals of the mica group [1]. They have a structure similar to that of muscovite, but are typically deficient in alkalis, with less Al substitution for Si. The general formula for illites is $K_yAl_{4(}Si_{8-y,}Al_y)O_{20}(OH)_4$, usually with $1<y<1.5$, but in the case of possible charge imbalances, Ca and Mg can be substituted for K. The K, Ca, and Mg interlayer cations prevent the inclusion of water into the structure [2]. It is well known that the chemical structure of minerals is not the only factor that determines their adsorption characteristics. The size and shape of their particles also plays a critical role in determining their surface properties.

In traditional oriental medicine texts, illite has been taken orally or used topically. The essential minerals within the clay are released and the body absorbs those it needs to maintain health and vigor. Illite is believed to hinder the exacerbation of infection and have a regenerating action on the tissues. It is absorbent, adsorbent, antiseptic, antibacterial and hemostatic [3-4]. Unlike chemical medicines, which can destroy healthy tissues and beneficial bacteria as well as bad, illite is selective allowing healing to take place at a natural rate. Illite also possesses analgesic properties effective in relieving muscular or joint pains by decongesting the affected area. In addition, Illite is a valuable beauty treatment and is the main ingredient in many natural face masks, bath and spa products. It has a deep cleansing action, removes dead skin cells, absorbs impurities, excess sebum and oils to keep the skin smooth, fresh and radiant [5-6].

Zinc oxide has a very broad and versatile range of application including technical products, cosmetics, and pharmaceutical uses. At present, zinc oxide is selling strongest in the rubber industry. Used as additive, it promotes the process of vulcanization in rubber that is used for tire manufacturing. In addition, its good conductivity improves the removal of heat that is generated during the churning motion of the tires. When added to cement, zinc oxide increases the water resistivity and prolongs the processing time. Zinc dust and “zinc white” are also used as pore fillers in surfacers and smoothing cements and as gray or white wall or artist’s paints. Moreover, zinc oxide is used as catalyst in the chemical industry or for manufacturing cosmetic products. Zinc oxide together with ichors develops into antiseptic and astringent zinc salts, which is why it is used by the pharmaceutical industry for manufacturing zinc ointments, zinc pastes, adhesive tapes, and bandages for skin and wound treatment. Zinc oxide is transparent in the visible range of the light spectrum and acts as a physical filter against the UV-B and particularly UV-A radiation of the sun [7-8].

In this work, ZnO/Illite composite materials with contents rate was characterized for crystalline growth, structure and weight loss by XRD, SEM and TG-DTA. Consequently, we have been studied to made composite materials with contents rate (30wt%-50wt%) ZnO loaded on the illite to overcome faults such as agglomerate and whiteness as sun block.

Experimental

The synthesis of ZnO nanoparticles loaded on illite was prepared by reaction for 2hr at the room temperature. Firstly, we are stirred for 30 min after added to EtOH in H_2O and then stirring add to illite powder with ZnO as much as 30wt%, 40wt%, 50wt%. The obtained solution was reacted stirring vigorously. Finally, ZnO/illite a mixed solution are dried in oven. The characterized for crystal structure, chemical bonding and morphology by XRD, FT-IR and SEM.

Results and Discussion

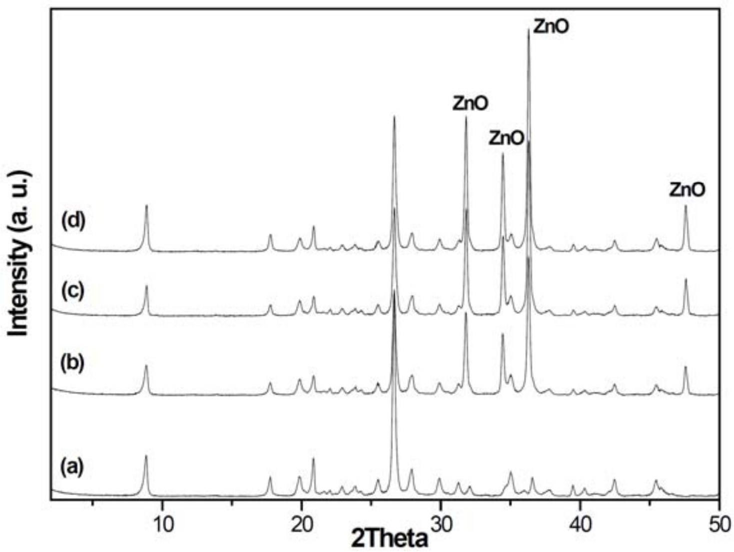

Fig. 1. Powder X-ray diffraction patterns of raw illite and 30%-50% ZnO nanosize loaded on the illite: (a) raw illite, (b) 30wt% ZnO, (c) 40wt% ZnO, (d) 50wt% ZnO.

The X-ray patterns of nanoparticles ZnO/Illite with contents rate prepared at room temperature is shown in Fig. 1.The ZnO nanoparticles is observed to be highly crystalline. ZnO is called the zincit and has the hexagonal wurzite type structure. The typical XRD diffraction peaks of raw illite and ZnO loaded on the illite are appeared shown in Fig. 1. The diffraction peaks in the XRD pattern clearly shows the crystalline nature with peaks corresponding to (100), (002), (101) and (102) planes. The results ZnO peaks is shown at 31.8°(100), 34.4°(002), 36.3°(101) and 47.6°(102) respectively, just the same reported in the literature. Above all things, intensities of the peak are grown with increase contents of ZnO loaded on the illite, namely ZnO loaded on the illite is could confirm well dispersed ZnO nanopowder by scanning electron microscope(SEM) images.

The surface morphology of nanosize ZnO loaded on the illite is as shown in Fig. 2. The SEM pictures clearly show the average size of illite plate. The nanosize ZnO loaded on the illite shows a little difference with increase ZnO contents ratios.

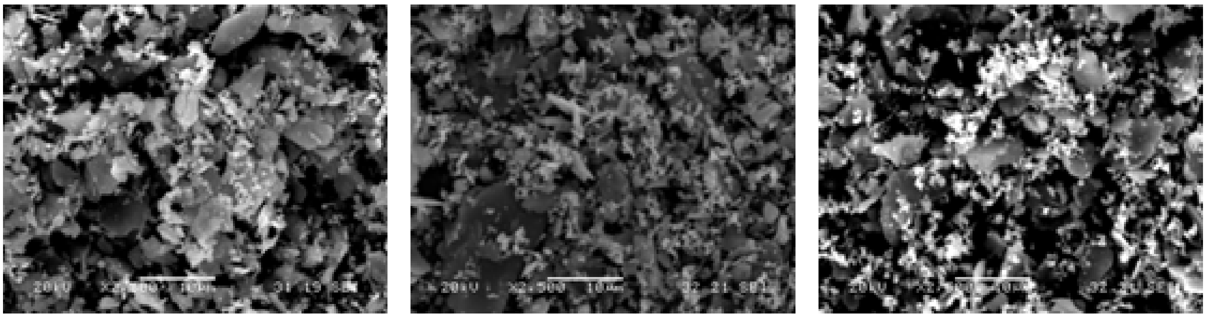

Fig. 2. SEM micrographs of nanosize ZnO loaded on the illite : (a) 30wt% ZnO, (b) 40wt% ZnO, (c) 50wt% ZnO.

FT-IR is a technique used to obtain information about the chemical bonding in a material. It is

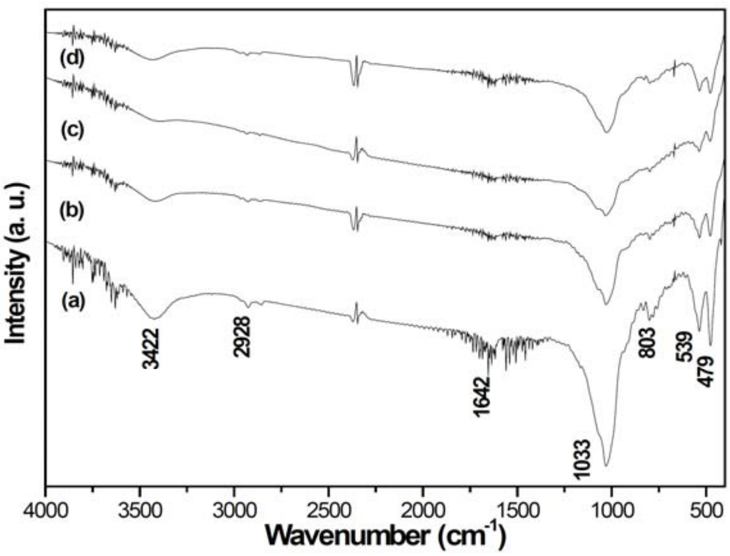

Fig. 2. FT-IR spectrum about different contents ZnO nanosize loaded on the illite: (a) raw illite, (b) 30wt% ZnO, (c) 40wt% ZnO, (d) 50wt% ZnO.

used to identify the elemental constituents of a material. The characteristic peaks exhibited by FT-IR spectra of ZnO nanosize loaded on the illite with contents rate are as shown in Fig. 3. The absorption band at 539 and 479cm^{-1} represents the stretching mode of Zn-O. The Zn-O bond is assigned to the stretching frequency around 500cm^{-1} for pure ZnO.

The prepared ZnO/illite particles show peak absorbance at 362nm which corresponds to average particle size of 10nm.

Conclusion

The ZnO nanoparticles is observed to be highly crystalline through XRD analysis. The diffraction peaks in the XRD pattern clearly. Absorption peak of the prepared sample is 262nm which is highly blue shifted as compared to the bulk (360nm). ZnO/illte is superior to the other cosmetic powders as a sunscreen ingredient. It is more protective against long-wave UVA and is less white at a given concentration.

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References

1. Z.Z. Zhang, G.W. Bailey, *Clays Clay Miner*., **46**, 290 (1998).
2. M. Rieder, G. Cavazzini, Y. D’Yakonov, V.A. Frank-Kamenetskii, G. Gottardi, S. Guggenheim, P.V. Koval, G. Muller, A.M.R. Neiva, E.W. Radoslovich, J.L. Robert, F.P. Sassi, H. Takeda, Z.Weiss, D.R.Wones, *Can. Mineral.*, **36**, 905 (1998).
3. Robertson, R. H. S., Cadavers, *Br. Miner. Soc. Bull*., **113**, 3 (1996).
4. Bech, J., *IX Simp. Grupo Especializado de Cristalografıa.La Cristalografıa y la Industria Farmaceatica. Ed. Reales Soc. Esp. Fıaica y Quıaica. Univ. Granada*, (1996).
5. Cornejo, J., Hermosin, M.C., White, J.L., Barnes, J.R., Hem, S.L., *Clays Clay Miner.*, **31**, 109 (1983)
6. Governa, M., Valentino, M., Visona, I., Monaco, F., Amati, M., Scancarello, G., Scansetti, G., *Cell. Biol. Toxic.*, **11**, 237 (1995).
7. Klingshirn, C., *Chem. PhysChem.*, **8**, 782 (2007).
8. S. Liang, H. Sheng, Y. Liu, Z. Huo, Y. Lu, H. Shen,, *J. Cryst. Growth*, **225**, 110 (2001).