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The effect of nano-sized starting materials and excessamount of Bi on the dielectric/piezoelectric properties of0.94[(BixNa0.5)TiO3]-0.06[BaTiO3] lead free piezoelectric ceramics

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In an approach to acclimate ourselves torecent ecological consciousness trend, a lead-free piezoelectric material, bismuth sodium titanate (abbreviated as BNT) based bismuth sodium bariumtitanate (abbreviated as BNT-BT), was considered as an environment-friendlyalternative for a lead based piezoelectric system. Ceramic specimens of0.94[(BixNa0.5)TiO3]-0.06[BaTiO3] (x = 0.500~0.515) compositions were preparedby a modified mixed oxide method. To increase the chemical homogeneity andreaction activity, high energy mechanical milling machine and pre-milled nanosized powder has been used. In this method (BixNa0.5)TiO3 (x=0.500~0.515) andBaTiO3 were prepared separately from pre-milled constituent materials at lowcalcination temperature and then separately prepared BNTX (X=1, 2, 3 and 4) andBT were mixed by high energy mechanical milling machine. Without furthercalcination step the mixed powders were pressed into disk shape and sintered at1110°C. Microstructures, phasestructures and electrical properties of the ceramic specimens weresystematically investigated. Highly dense ceramic specimens with homogenousgrains were prepared in spite of relatively low sintering temperature. Phasestructures were not significantly influenced by the excess amount Bi. Largevariation on the piezoelectric and dielectric properties was detected atrelative high excess Bi amounts. When x≤ 0.505, thespecimens exhibit insignificant variation in piezoelectric and dielectricconstant though depolarization temperature is found to be decreased. Considerableamount of decrease in piezoelectric and dielectric properties are observed withhigher excess of Bi amounts (x≥0.505). This researchindicates the advantages of high energy mechanical milling and importance ofproper maintenance of Bi stoichiometry.

Keywords: High energy mechanicalmilling, BNT-BT, Excess Bismuth

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물리적, 화학적 방법으로 환원된 그라핀의 분자구조

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본 연구에서는 Graphene oxide를 800℃, 질소분위기 하에서 환원시켜 얻은 GP_{TR}과 Hydrazine을 이용한 화학적 처리로 얻은 GP_{CR}의 분자구조를 제안하였다. 이때 grapheneoxide는 modified Hummers' method를이용하여 제조하였다. GP_{TR}과 GP_{CR}은 모두 표면에 몇몇의 oxide group이 존재하는데GP_{TR}은 six layer로 $C_{100}O_{3\pm1}$ 의 조성을 갖고 GP_{CR}은 three layer로 and $C_{100}O_{6.5\pm2}$ 의 조성을 갖는다. 그리고 면간간격은 GP_{TR}은 3.432 Å, GP_{CR}은 3.760 Å으로 전형적인 방법인 top downprocess로 얻은 graphene 보다 다소 크다는 것을 알 수 있다.

Keywords: graphene