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고주파 소자용 $BaTi_4O_9$ 박막의 구조와 유전특성 연구

Investigation of Structures and Dielectric Properties of $BaTi_4O_9$ Thin Film as the Material for High Frequency Microwave Devices

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차세대 이동통신(Future Mobile Telecommunication)을 위한 rf 수동소자는 4 GHz 이상의 높은 동작주파수와 소형화가 계속적으로 요구되어지고 있다 이러한 요구사항을 만족시킬 수 있는 방법으로는 능동소자와 MMIC가 가능한 새로운 구조의 소동소자의 개발이 요구되어진다 따라서, 고주파 수동소자의 MMIC화를 위한 소재개발이 최우선이 되어야 한다 본 연구에서는 rf magnetron sputtering을 이용하여 $Pt/Ti/SiO_2/Si$ 기판위에 온도보상용 고주파 유전체로 알려진 $BaTi_4O_9$ 박막을 성장하여 고주파 소재로서의 가능성을 확인하였다 증착온도, 인가전압, 후열처리 온도와 같은 공정 변수에 따른 $BaTi_4O_9$ 박막의 구조변화, 표면특성 및 유전특성을 연구하였다 450°C 이상의 증착온도와 80 W 이상의 인가 전압을 가한 상태에서 증착한 후, 800°C 이상의 온도에서 후열처리를 하였을 때, $BaTi_4O_9$ 박막을 얻을 수 있었으며, 550°C에서 80 W의 전압을 인가하여 증착한 후, 900°C에서 후열처리한 $BaTi_4O_9$ 박막의 유전율은 약 38, 손실계수는 약 0 6%였다

구두발표

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Observation of Microstructural Evolution in Ferroelectric PZT Thin Films by Scanning Force Microscopy

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Lead Zirconate Titanate (PZT) thin films are gaining interest as prospective materials for applications in DRAM capacitors and nonvolatile memories because of their remarkable ferroelectric and dielectric properties Physical and chemical methods, such as sputtering, PVD, CVD, sol-gel and Metallorganic Deposition (MOD) are some of the most popular methods to produce PZT thin films Among them, the sol-gel process draws much technological attentions because of its unique advantages on changing compositions and ease to dope with impurities, and ability to make large coatings Understanding the mechanisms of the nucleation and growth in ferroelectric PZT thin film will be of vital importance in optimizing the sol-gel process Scanning force microscopy modified to detect the piezoresponse from ferroelectric thin films is used in this study We have investigated the piezoelectric response of sol-gel PZT (52/48) thin film with 300 nm in thickness As-prepared PZT films were annealed in conventional tube furnace at from 300°C to 600°C with holding time of 10~240 min Detailed ferroelectric domain images are obtained from the annealed PZT films above at 500°C In particular, the isolated ferroelectric phases are observed in the annealed films between 400~500°C The evolutions of the isolated ferroelectric phases are used to study the kinetics of phase transformation in the thin films The kinetic process of growth was modeled using the Avrami equation The Avrami coefficient n and growth rate constant k is determined, as well as the activation energy The results taken from SFM are more reliable than other microscopic techniques, such as TEM or SEM, because of capability to scan larger area and to detect in high resolution (~10 nm in lateral) Moreover, kinetic studies of phase transformation from pyrochlore to perovskite are help to develop low-temperature processing