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## Behaviour of nitrided layer formed on S45C carbon steel during gaseous nitriding

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재료의 표면 강화 방법 중의 하나인 질화공정을 이용하여 탄소강 S45C 소재의 질화 거동에 대하여 연구하였다. 520℃ 온도에서 질화 공정을 진행하여 공정시간에 따른 Kn값을 수소 센서로 측정하여 공정시간에 따른 N-potential의 변화와 그에 따른 화합물층 성장 및 화합물층의 상변화에 대해 관찰하였다. 화합물 층의 미세구조 변화는 광학현미경 및 주사전자현미경을 통해 관찰하였다. 가스 질화 처리 후 표면경도는 약 600Hv의 경도값이 측정되었고, 공정 시간이 늘어남에 따라 화합물층 및 경화깊이가 증가되고 표면 화합물이 성장하여 porous가 감소하는 것을 확인 할 수 있다. 경화깊이는 1440분 일 때 약 0.5mm 경화깊이를 얻었고, 화합물층의 성장은 ε상(Fe2-3N)과 γ′상(Fe4N)으로 두 개의 상으로 형성되는 것을 관찰할 수 있었다. 시험 결과를 바탕으로 S45C 소재의 탄소 함량에 따른 lehrer diagram을 열역학 적으로 계산하고 화합물층의 형성 기구에 대해 비교 분석하였다.

**Keywords:** Gas Nitriding, Nitriding potential, Compound layer, Carbon steel S45C

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## Impedance-Based Characterization of 2-Dimenisonal Conduction Transports in the $LaAlO_3/Sr_xCa_{1-x}TiO_3/SrTiO_3$ systems

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The 2-dimensiona electron gas (2DEG) layers have opened tremendous interests in the heterooxide interfaces formed between two insulating materials, especially between $LaAlO_3$ and $SrTiO_3$. The 2DEG layers exhibit extremely high mobility and carrier concentrations along with metallic transport phenomena unlike the constituent oxide materials, i.e., $LaAlO_3$ and $SrTiO_3$. The current work inserted artificially the interfacial layer, $Sr_xCa_{1-x}TiO_3$ between $LaAlO_3$ and $SrTiO_3$, with the aim to controlling the 2-dimensional transports. The insertion of the additional materials affect significantly their corresponding electrical transports. Such features have been probed using DC and AC-based characterizations. In particular, impedance spectroscopy was employed as an AC-based characterization tool. Frequency-dependent impedance spectroscopy have been widely applied to a number of electroceramic materials, such as varistors, MLCCs, solid electrolytes, etc. Impedance spectroscopy provides powerful information on the materials system: i) the simultaneous measurement of conductivity and dielectric constants, ii) systematic identification of electrical origins among bulk-, grain boundary-, and electrode-based responses, and iii) the numerical estimation on the uniformity of the electrical origins. Impedance spectroscopy was applied to the $LaAlO_3/Sr_xCa_{1-x}TiO_3/SrTiO_3$ system, in order to understand the 2-dimensional transports in terms of the interfacial design concepts. The 2-dimensional conduction behavior system is analyzed with special emphasis on the underlying mechanisms. Such approach is discussed towards rational optimization of the 2-dimensional nanoelectronic devices.

**Keywords:** 2DEG, LaAlO3, $SrTiO_3$