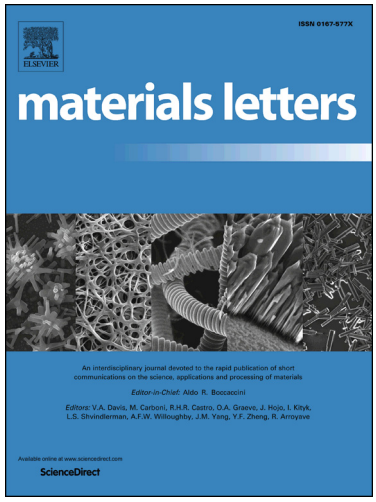

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Structure of coherent Mg_3TiO_4 oxide formed between TiN and MgO

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ABSTRACT

Solid state reaction in nanometer scale at the interface between TiN and MgO can result in formation of Mg_3TiO_4 particles which has not reported before. The structure of the newly found oxide is characterized with spherical-aberration corrected scanning transmission electron microscopy at atomic resolution with x-ray energy dispersive spectroscopy. The nanosized Mg_3TiO_4 oxide particles formed in MgO underneath the epitaxial TN film with cube-on-cube coherent relationship with both MgO and TiN, i.e. TiN(100) || Mg-Ti-O(100) || MgO(100) and TiN[110] || Mg-Ti-O[110] || MgO[110]. Mg_3TiO_4 is identified to have cubic structure (lattice parameter a = 0.842 nm) with space group of $Fd\bar{3}m$.

Keywords: Interface, particles, structure, electron microscopy

1. Introduction

Titanium nitride (TiN) epitaxial film grown on MgO substrate has been studied extensively for understanding the growth kinetics and film properties because a high quality film can be easily obtained as a result of both TiN and MgO having the same cubic rock salt structure (space group $Fm\bar{3}m$) with similar lattice constant (a_{TiN} = 0.424 nm and a_{MgO} = 0.421 nm) [1,2]. Recently, spherical-aberration corrected annular dark field scanning transmission electron microscopy (ADF-STEM) which provides atomic resolution capability has become a powerful and mainstream technique for investigation of interphase and grain boundaries with phase and structural changes as the ADF-STEM image in Z contrast can provide precise and simple interpretation about the atomic structure in details [3-5]. In our previous study of the TiN/MgO interfacial structure by applying STEM, positions of atomic columns for Ti, Mg, O, and N can be revealed at atomic resolution from which a fully coherent diffuse interface between TiN and MgO can be recognized [6]. The interdiffusion between TiN and MgO may result in further formation of