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Mechanical and chemical investigation of the interface between tungsten-based metallizations and annealed borophosphosilicate glass

B. Völker^{1,2}, W. Heinz¹, K. Matoy³, R. Roth³, J.M. Batke⁴, T. Schöberl⁵, M.J. Cordill⁵ and G. Dehm^{6*}

¹ KAI - Kompetenzzentrum Automobil- und Industrieelektronik GmbH, Technologiepark Villach, Europastrasse 8, 9524 Villach, Austria

² Department Materials Physics, University of Leoben, 8700 Leoben, Austria

³ Infineon Technologies AG, 9500 Villach, Austria

⁴ Infineon Technologies AG, 93049 Regensburg, Germany

⁵ Erich Schmid Institute of Materials Science, Austrian Academy of Sciences, Jahnstrasse 12, 8700 Leoben, Austria

⁶ Max-Planck-Institut für Eisenforschung GmbH, 40237 Düsseldorf, Germany

* Corresponding author. E-Mail: dehm@mpie.de

Abstract

The focus of this study was on the interface between W-based metallizations and an annealed borophosphosilicate glass (BPSG) dielectric. W-based metallizations are often used in semiconductor devices because of their favourable properties as a diffusion barrier. The interface was characterized mechanically and chemically. For the determination of the interface energy release rate the 4-point-bending method was used. The fracture surfaces resulting from the 4-point-bending experiments were examined to determine the failing interface and the topography of the fracture surfaces. Chemical characterizations of intact interfaces were performed using an electron dispersive x-ray approach in a scanning transmission electron microscope to provide information why Ti incorporated in a W-layer improves the adhesion on annealed BPSG significantly compared to a pure W-layer.

Keywords: 4-point-bending; interface; interface energy release rate; Ti enrichment at interface; W-based metallization;

1. Introduction

Semiconductor devices play an important role in everyday life. They usually consist of a multitude of layers of different materials. Hence, mechanical and chemical properties at the interface play an important role in such devices and need to be understood. Interfaces between metallic conductors and dielectric insulators are essential for the functionality of such devices. But such interfaces are usually mechanically weak [1–10] and prone to fail during service. A

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