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Tungsten Sputtering Film using AJA#2 Sputter with Ar

Objective: To study the sputtering rate, resistivity, and stress of tungsten films using AJA#2 sputtering tool with Ar as working gas.

Experimental: Tungsten films were sputtered onto thermally-oxidized Si pieces (~500nm thick SiO2) for 4-probe resistivity measurements (after the resistivity measurements, these pieces were cleaved for SEM to get the film thickness as well as cross-section profile) and 4" Si wafers for stress measurements. Prior to each film sputtering, the chamber were W coated for 10 min. The gun angle, z-distance (the sample height), and sample rotation speed were set to 5, 2.75, and 10rpm, respectively.

Results and Discussions:

a) Sputtering W with the use of Ar.

Table 1

W Sputtering Film using AJA#2 with Ar [Power=200W, Ar Flow-rate=25sccm, Gun-angle=5, z=2.75, Rotation speed=10rpm]			
Pressure (mT)	Sputtering Rate (nm/min)	Resistivity (Ohm-cm)	Stress (MPa)
5	8.4	3.0E-05	2075.7
10	10.4	5.1E-04	186.64
20	13.6	3.2E-03	-210.89

The sputtering rate of W film increases with the increases of pressure.

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Figure 1 Cross-section of the W films sputtered using Ar: a) 5mT; b) 10mT; c) 20mT.

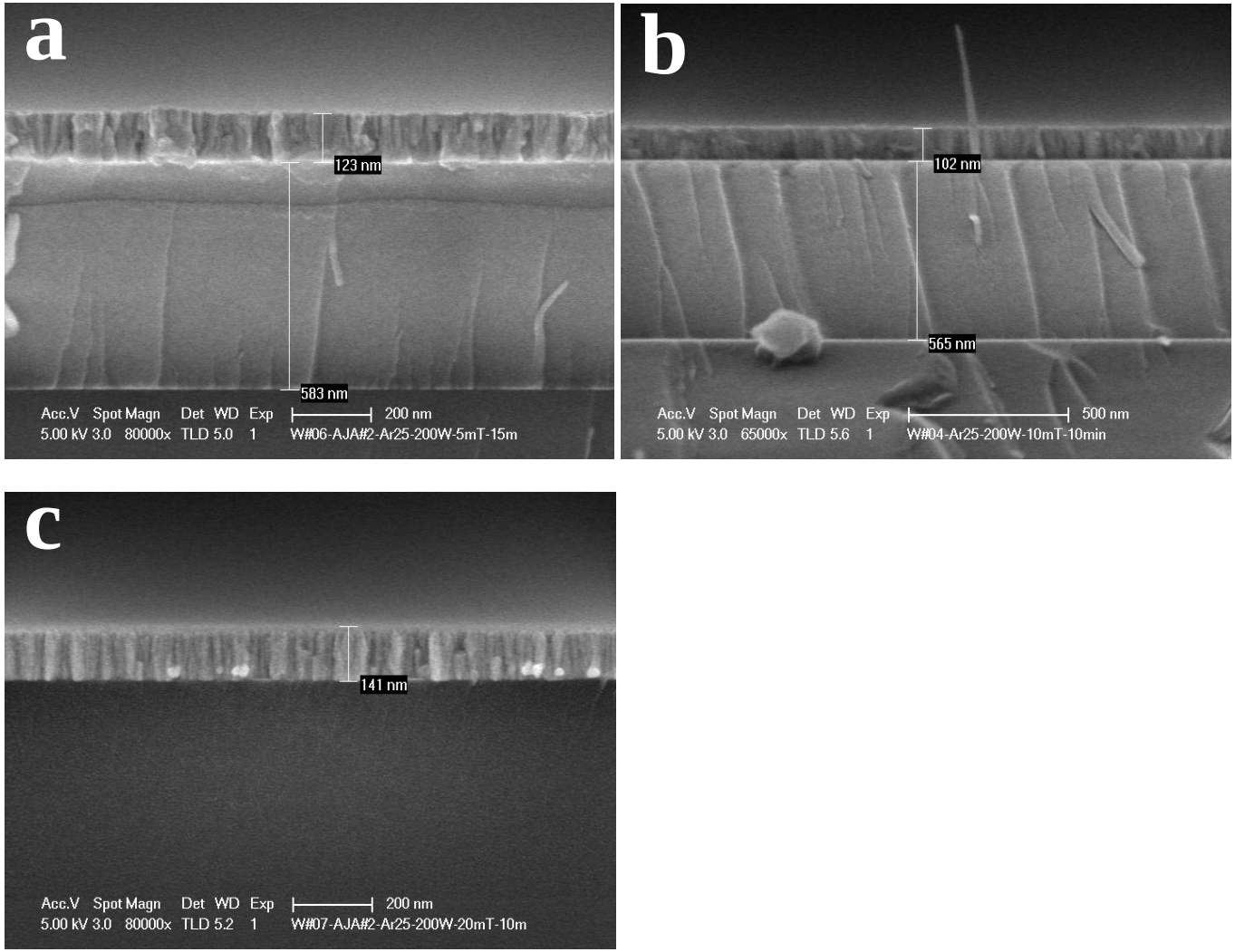
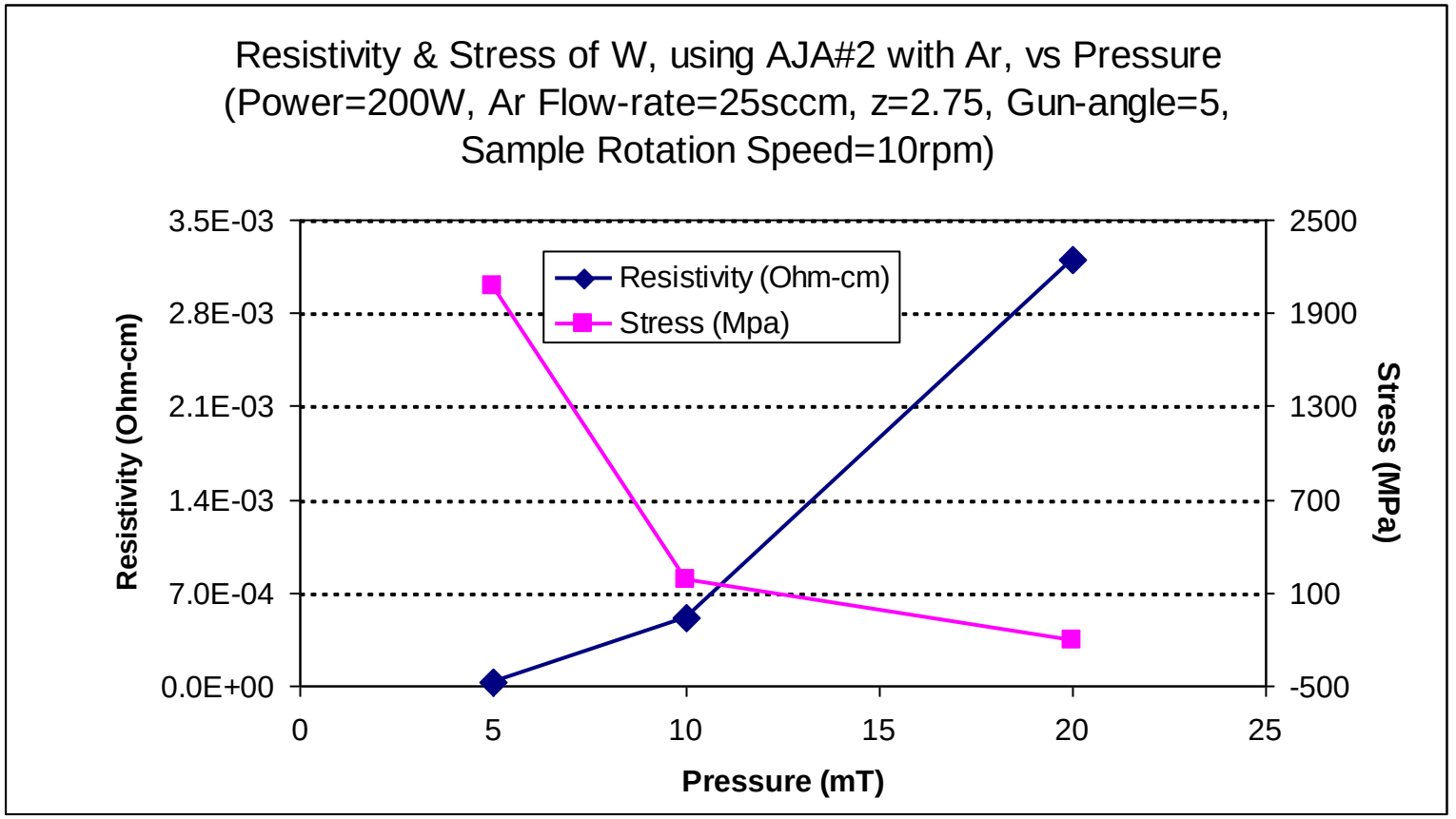


Figure 2 Resistivity and stress of W as functions of pressure with the use of AJA#2 sputter. The sputtering parameters are Ar flow-rate=25 sccm, power=200W, z=2.75, gun-angle=5, and rotation-speed=10rpm.



As seen from Figure 2, the resistivity increases with the increase of pressure, while the stress is tensile and decreases as the pressure rises from 5 to 10mT, then, becomes compressive as the pressure further rises to 20mT.

Table 2

W Sputtering Film using AJA#2 with Ar [Pressure=10mT, Ar Flow-rate=25sccm, Gun-angle=5, z=2.75, Rotation speed=10rpm]		
Power (W)	Sputtering Rate (nm/min)	Resistivity (Ohm-cm)
100	5.74	9.2E-04
200	10.4	5.1E-04

As noted from Table 2, the sputtering rate of W increases, while the resistivity decreases, with the increase of the power from 100 to 200W.

Figure 3 Cross-section of the W films sputtered using Ar: a) 100W; b) 200W.