Well-behaved Pd/GaAs Schottky Diodes Fabricated by Electroless Plating

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INTRODUCTION

In recent years, it has been noticed that higher Schottky barrier heights (SBHs) of the Pd/GaAs Schottky diodes can be obtained via electrochemical deposition. The Fermi-level pinning effect is eliminated due to the low-temperature deposition of Pd film. However, the electric characteristics as well as the surface morphologies seems strongly affected by the plating conditions. In this work, the electroless plating technique was employed to fabricate Pd/GaAs Schottky diode. Effects of plating conditions, such as bath compositions, temperature, and sodium ion interference on the Schottky diode characteristics were investigated by *I-V* measurements. In addition, the surface morphologies of the Pd film were also studied by SEM observation.

EXPERIMENT

The Pd/GaAs devices were fabricated on an n-type epitaxial GaAs substrate. The AuGe film was deposited by thermal evaporation for Ohmic contact. And, the Pd was deposited by electroless plating technique at 30℃ for 10 min. The original composition of the plating bath denoted as 1X was listed in Table 1. For the sodium-free bath, the chelating agent, Na_2EDTA was replaced by H_4EDTA.

RESULTS AND DISCUSSION

As shown in Fig. 1, the Pd/GaAs Schottky barrier heights of the devices fabricated by EP technique exhibited strong dependence on the plating bath concentrations, and Pd precursor concentrations. By lowering the bulk concentration or Pd precursor concentrations only, the higher barrier height could be obtained. From the SEM observations, it revealed that the barrier height increased with decreasing the crystalline grain size of Pd. However, the SBH didn't vary significant with the concentration of the reducing agent N_2H_4. From Fig. 2, it was observed that higher SBH was obtained when the plating temperature was lowered. In the presence of sodium ion, the interface charge state density of the Pd/GaAs Schottky contact increased and therefore caused the lowering of SBH. When the Na_2EDTA in the plating bath was replaced by H_4EDTA, the Pd/GaAs behaved better performance with higher SBH as shown in Table 2.

CONCLUSION

Well-behaved Pd/GaAs Schottky diodes can be fabricated by electroless plating at low bath concentration and low temperature. Besides, the SBHs of the Pd/GaAs diodes can be further increased by using sodium-free plating bath.

Table 1. The original concentration (1X) of plating bath composition.

NH_4OH	390 ml/l
Na_2EDTA	70 g/l
(or H_4EDTA)	(55 g/l)
$PdCl_2$	5.4 g/l
N_2H_4	200 ml/l

Table 2. Schottky barrier heights of Pd/GaAs plated in the Na-present and Na-free baths.

	Barrier height (meV)	
	Na-form bath	Na-free bath
0.125X	910	916
0.5X	863	906

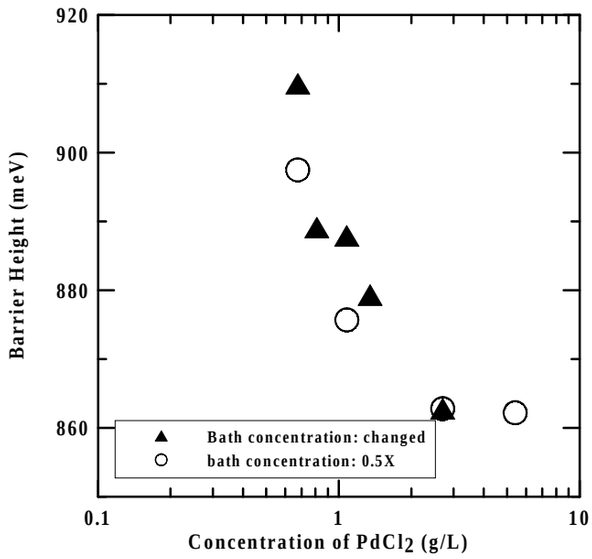

Fig. 1. Effect of $PdCl_2$ concentration on SBH of the resultant Pd/GaAs Schottky diodes.

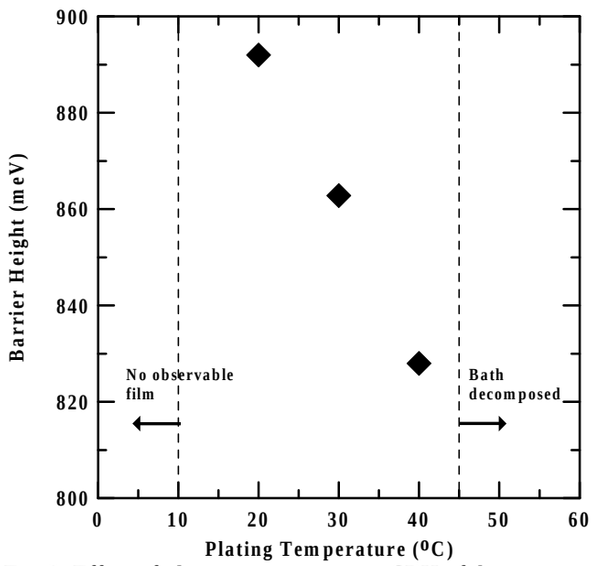

Fig. 2. Effect of plating temperature on SBH of the resultant Pd/GaAs Schottky diodes. (bath concentration: 0.5X)