Investigation on Optimal Poling Condition of PNN-PZT/Epoxy Paint Sensor and Its Sensitivity Improvement

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***Abstract*—This paper investigates optimal poling condition for PNN-PZT ($Pb(Nb,Ni)O_3$-$Pb(Zr,Ti)O_3$)/Epoxy paint sensor, and how to improve the piezoelectric performance of the PNN-PZT powder used in the paint sensor. Piezoelectric paint sensor can be easily spread on the curved or complex shaped structures, and can detect impact or vibration signal occurring on the structure thanks to piezoelectric powder's inherent electromechanical properties. In order to enhance the sensitivity of the paint sensor, piezoelectric properties of the piezoelectric powder should be improved. For this, we have changed sintering temperatures: 1,000, 1,100 and 1,250 degree Celsius. Finally, optimal poling conditions were obtained from several experiments to maximize piezoelectric sensitivity of paint sensors made by sintered ceramic powders at each temperature.**

Keywords—paint sensor; PNN-PZT; poling; sensitivity; smart paint, sintering

I. INTRODUCTION

Piezoelectric material is an electro-mechanical transducer, which converts mechanical energy to electrical energy, and vice versa [1]. Many investigators have studied on piezoelectric materials due to the high conversion efficiency between the electric signal and the mechanical signal [2]. Piezoelectric ceramic sensors have many good advantages in terms of sensitivity, and frequency bandwidth, so that they can be easily found in many engineering fields such as impact detection, vibration monitoring, and so on. However, their brittleness limits their applications to directly impacted regions and complicated shaped structures. On the other hand, piezoelectric polymer sensors are quite flexible, but they have low sensitivity and narrow operating temperature range. Piezoelectric paint sensor is a kind of piezoelectric composites, and can be tailored to appropriate applications between polymer and ceramic sensors by simply changing mixture ratio of the piezoelectric ceramic power to the resin or using different piezoelectric materials and resins [3-4]. In this study, we used PNN-PZT/Epoxy paint sensor and investigated how to improve the sensitivity of the paint sensor in terms of material base and fabrication methods [5-6].

II. FABRICATION PROCEDURE FOR THE PNN-PZT/EPOXY PAINT SENSOR

Fig. 1 (a) shows the fabrication procedure of the PNN-PZT powder for the paint sensor or ceramic disk, and Fig. 1 (b) shows the fabrication procedure of PNN-PZT/Epoxy paint sensor.

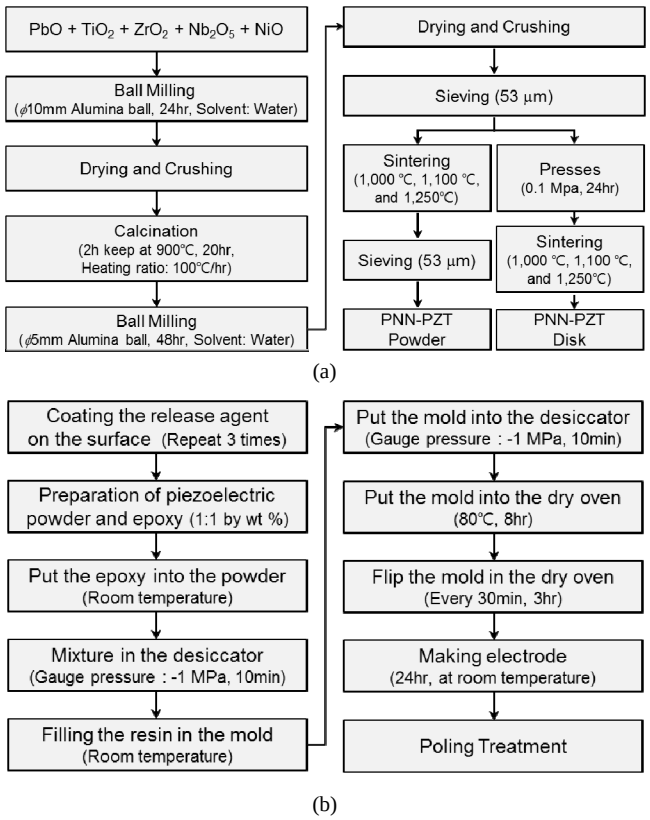

Fig. 1. Fabrication procedure: (a) PNN-PZT powder and disk; (b) Paint sensor.

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