課題番号　　　　　　　　:F-13-WS-0012
利用形態　　　　　　　　:技術代行
利用課題名（日本語）　　:XeF_2を用いた Si エッチング過程における温度上昇
Program Title (English)　:Temperature measurement during silicon etching using XeF2

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1. 概要（Summary）

We examined a batch fabrication method which enables the polydimethylsiloxane (PDMS) diaphragm integration with a sputtered thin film permanent magnet (TFPM). The proposed process is to firstly sputter TFPM on Si substrate, followed by coating with PDMS, and then etch silicon using XeF_2.
However, the heat generated during XeF_2 etching rendered the TFPM low performance. The predicted TFPM temperature during etching is over 165℃. So it is necessary to measure the temperature during XeF_2 etching process. As the XeF_2 reaction condition is performed in 150Pa pressure and room temperature. We plan to use infrared thermometer to measure the TFPM temperature during etching.

2. 実験（Experimental）

Experimental measurements of the substrate temperature were carried out. Since the etching process was performed in a vacuum chamber with XeF_2, a non-contact temperature measurement using an infrared thermometer (FTK9S-R80A-10S61, Japan Sensor Corp.) was adopted. The experimental configuration and setup are shown in Fig. 1.

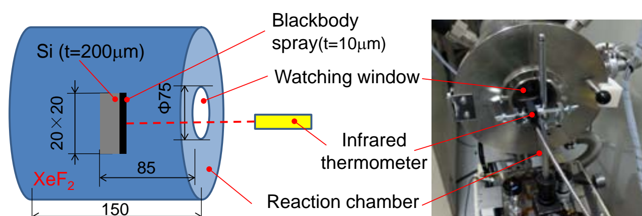

Fig. 1: Temperature measurement configuration and setup

3. 結果と考察(Results and Discussion)

The temperature measured during the etch process is shown in Fig. 2. This increases rapidly when the XeF^2 valve is opened, and reaches a peak of 450K. This temperature is responsible for the degradation in the magnetic performance of the TFPM mentioned in the summary, since the temperature resistance and Curie temperature of the TFPM are 438K and 583 K, respectively. The temperature drops immediately when the XeF_2 valve is closed.

Fig. 3 shows the variation in the maximum substrate temperature with pressure. As the pressure decreases, the maximum temperature also decreases.

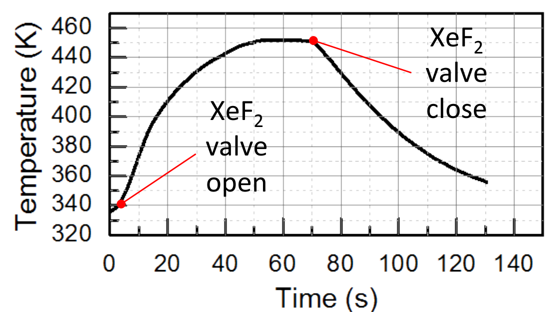

Fig. 2: Si temperature during the etching process

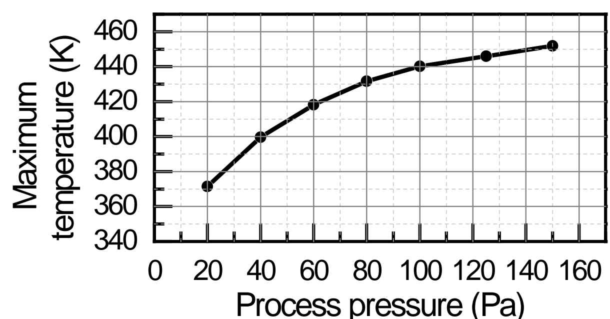

Fig. 3: Temperature dependence on process pressure

4．その他・特記事項（Others）

5．論文・学会発表（Publication/Presentation）

(1) C. Zhi, T. Shinshi, M. Uehara, A. Matsutani, I. Yuito, T. Takeuchi, “A polydimethylsiloxane diaphragm integrated with a sputtered thin film NdFeB magnet”, Microsystem Technologies (in press)

⑵ C. Zhi, T. Shinshi, M. Uehara, A. Matsutani, I. Yuito, T. Takeuchi, “A Micro Polydimethylsiloxane Diaphragm Integrated with a Sputtered Thin Film NdFeB Magnet,” Proceeding of 17th International Conference on Mechatronics Technology, MMN04, Jeju island, Korea, Oct 2013. (Oral presentation)

6．関連特許（Patent）

なし