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**United States Patent** [19]  
**Kawamata et al.**

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- [54] **PROCESS FOR PRODUCING THIN FILM**
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both of Hachioji, Japan
- [73] Assignee: **Olympus Optical Co., Ltd.,** Japan
- [21] Appl. No.: **08/683,195**
- [22] Filed: **Jul. 18, 1996**
- [30] **Foreign Application Priority Data**  
Jul. 20, 1995 [JP] Japan ..... 7-184454
- [51] **Int. Cl.<sup>6</sup>** ..... **C22C 23/00**
- [52] **U.S. Cl.** ..... **148/420; 420/402; 359/580;**  
204/192.12; 204/192.26; 204/192.29; 204/298.09
- [58] **Field of Search** ..... 204/192.12, 192.26-192.29,  
204/298.09; 148/420; 420/402; 359/580

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[57] **ABSTRACT**

A substrate (2) is rotatably installed in a vacuum chamber (1) at an upper part thereof MgF<sub>2</sub> granules (3) as a film source material are placed in a quartz boat (4) and mounted on a magnetron cathode (5). The magnetron cathode (5) is connected through a matching box (6) to a 13.56 MHz radio frequency power source (7). Cooling water (8) for holding the temperature of the magnetron cathode (5) constant flows against a lower face of the magnetron cathode (5). A side wall of the vacuum chamber (1) is provided with gas introduction ports (9), (10) for introducing gas in the vacuum chamber (1). A shutter (11) is placed between the magnetron cathode (5) and the substrate (2). This structure provides a process enabling forming a thin film at a high speed by sputtering, especially a high speed sputtering process enabling forming a thin fluoride film free of light absorption.

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11 Claims, 10 Drawing Sheets

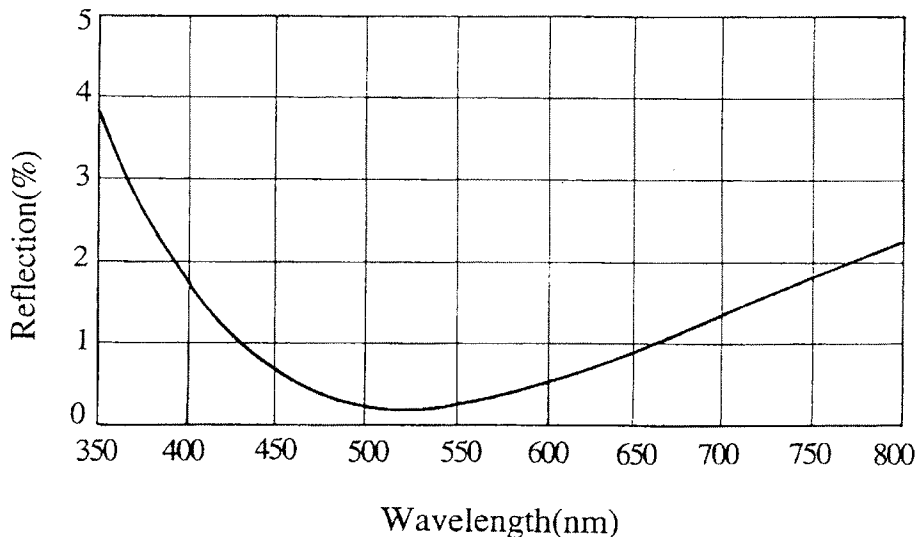


FIG. 1

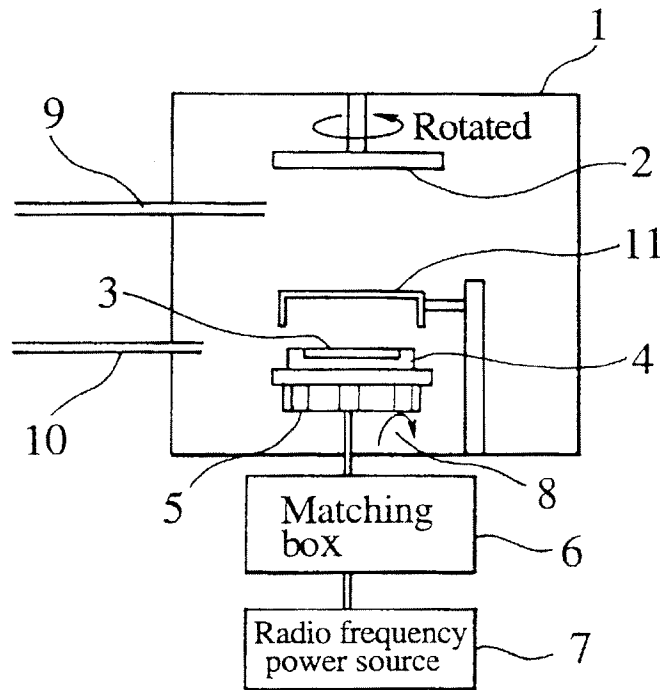


FIG. 3

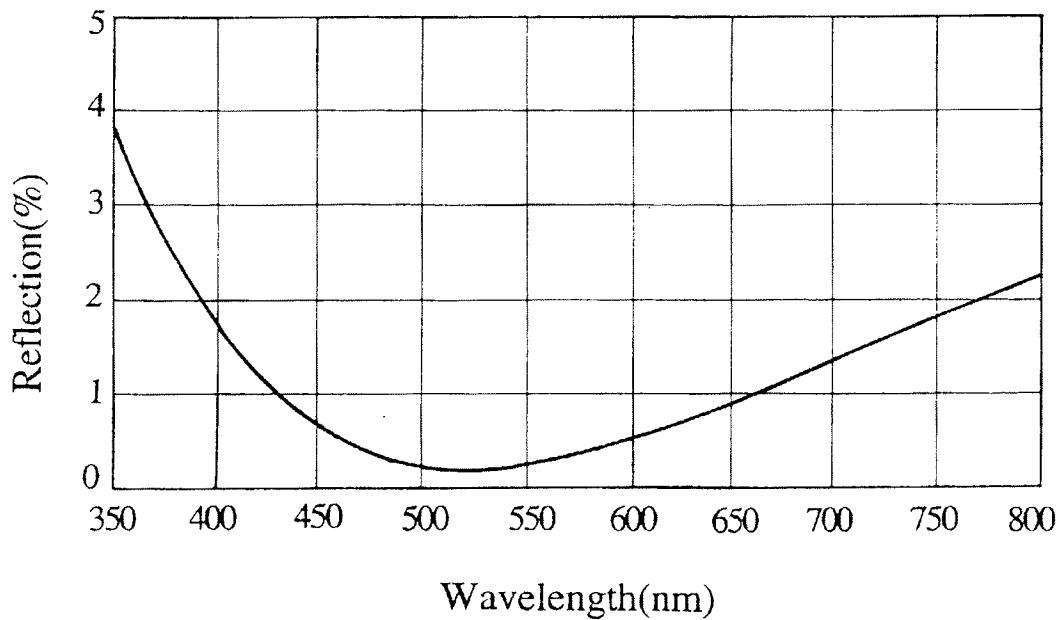


FIG. 2

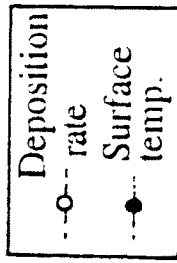
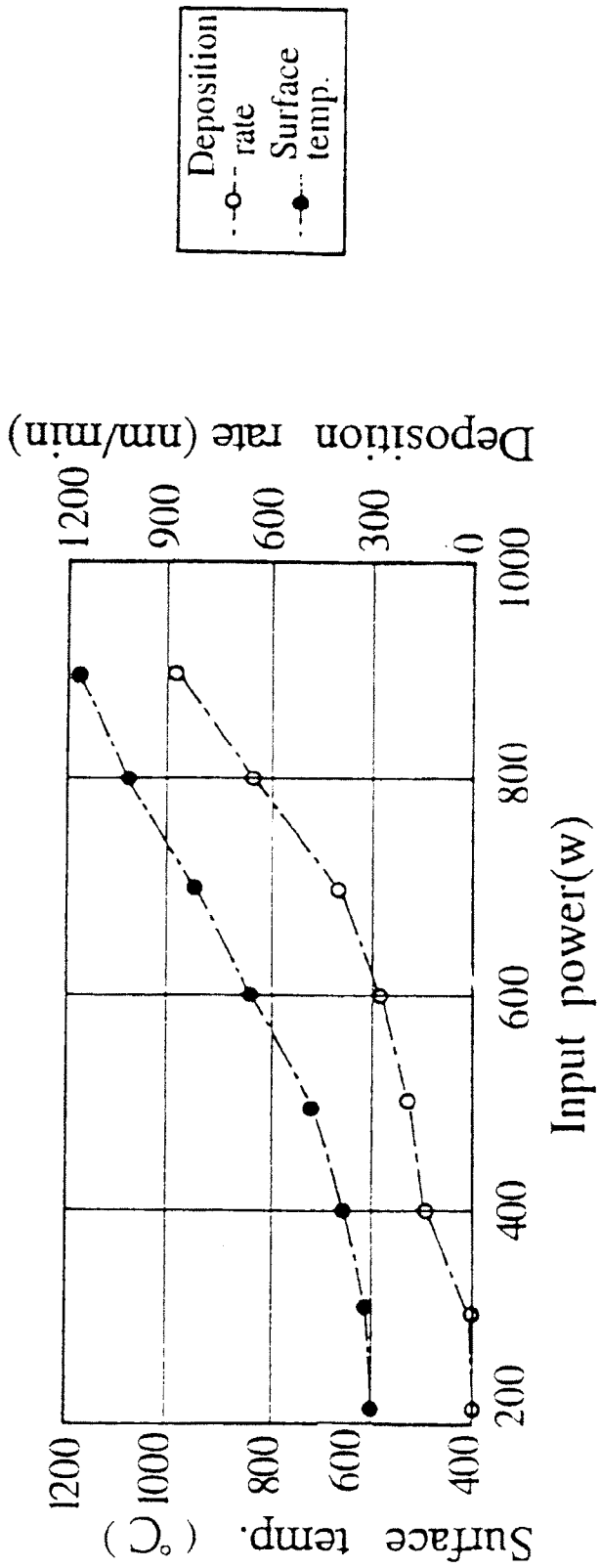


FIG. 4

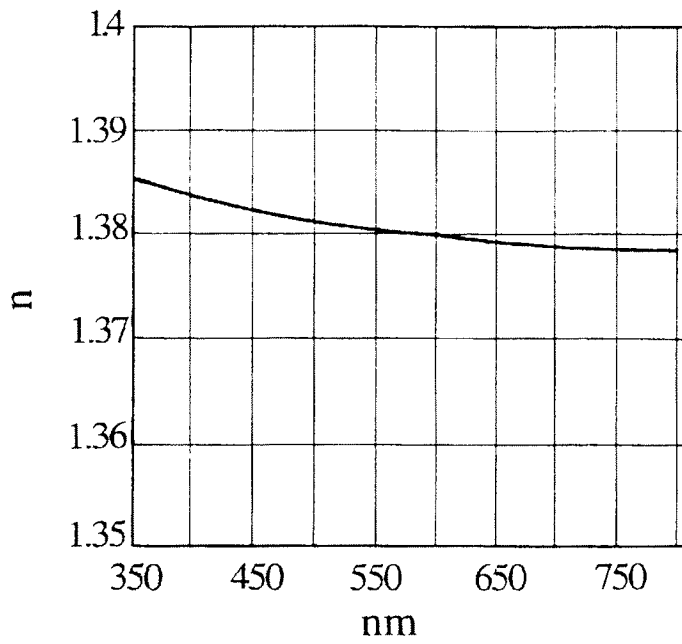


FIG. 5

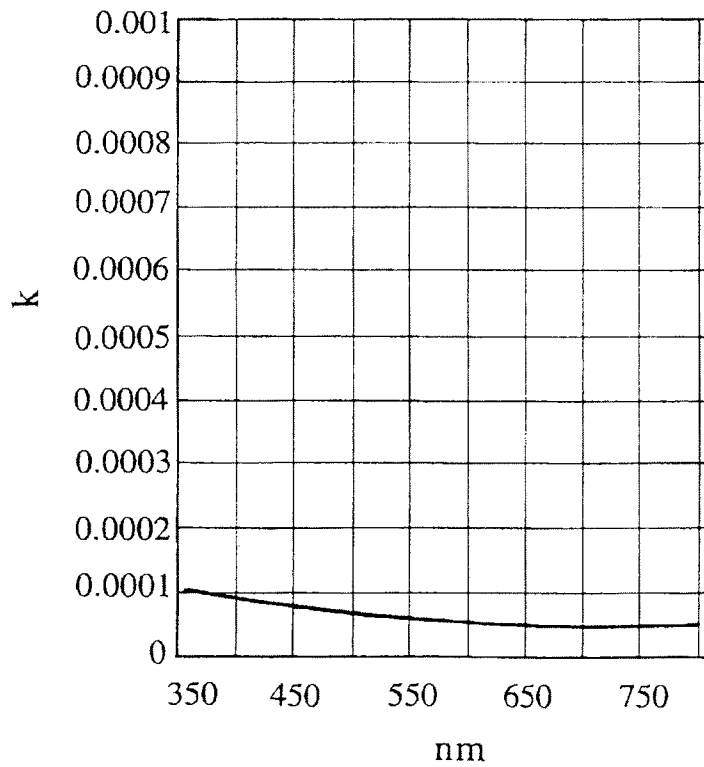
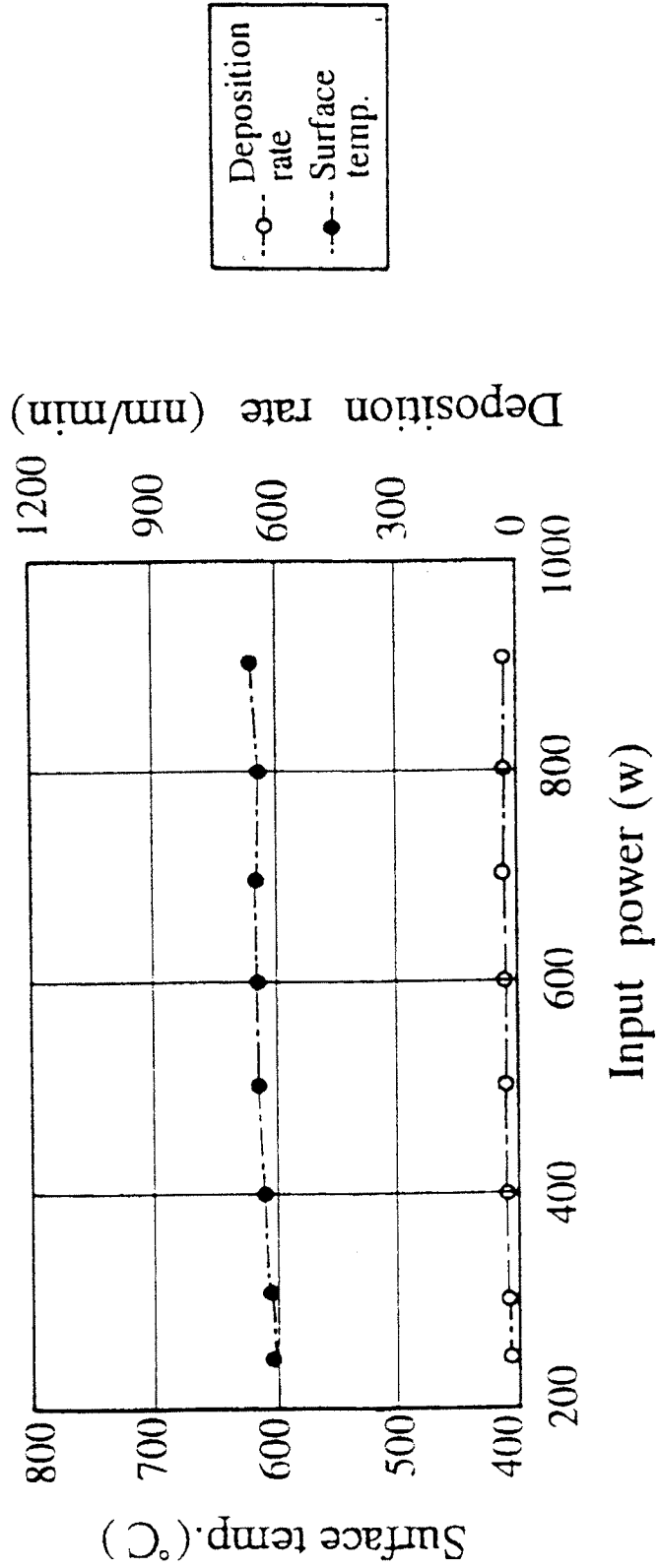


FIG. 6



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