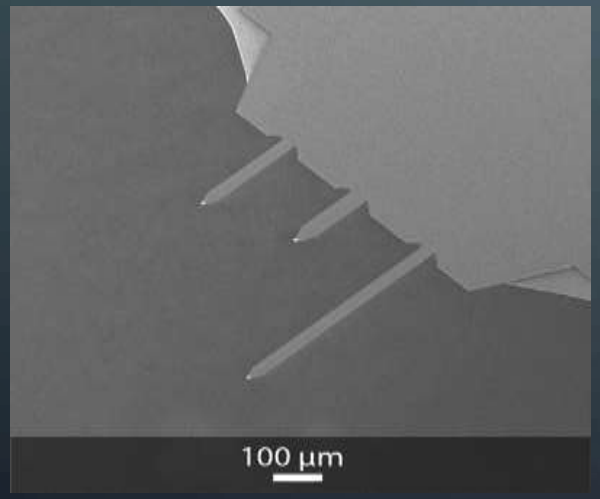
FABRICATION OF MEMS CANTILEVER



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INTRODUCTION

Silicon nitride is a popular material for fabricating Micro-Electro-Mechanical systems (MEMS) cantilevers due to its excellent mechanical properties, high thermal conductivity, chemical inertness.

The resulting silicon nitride MEMS cantilever is a flexible, beam-like structure with properties such as stiffness, resonant frequency, and sensitivity that can be used for various applications.

For example, it can be used as a sensor to detect changes in temperature, pressure, or chemical composition.

It can also be used as an actuator to control the motion of other objects.

PROCEDURE

1. RCA Cleaning : To remove organic and metallic contaminants

RCA 1 - Immerse the wafer sequentially in solutions of ammonium hydroxide, hydrogen peroxide which removes organic contaminants

RCA 2 - Immerse the wafer sequentially in solutions of hydrogen peroxide, hydrochloric acid which removes metallic contaminants

2. PVD Silicon Nitride Deposition :

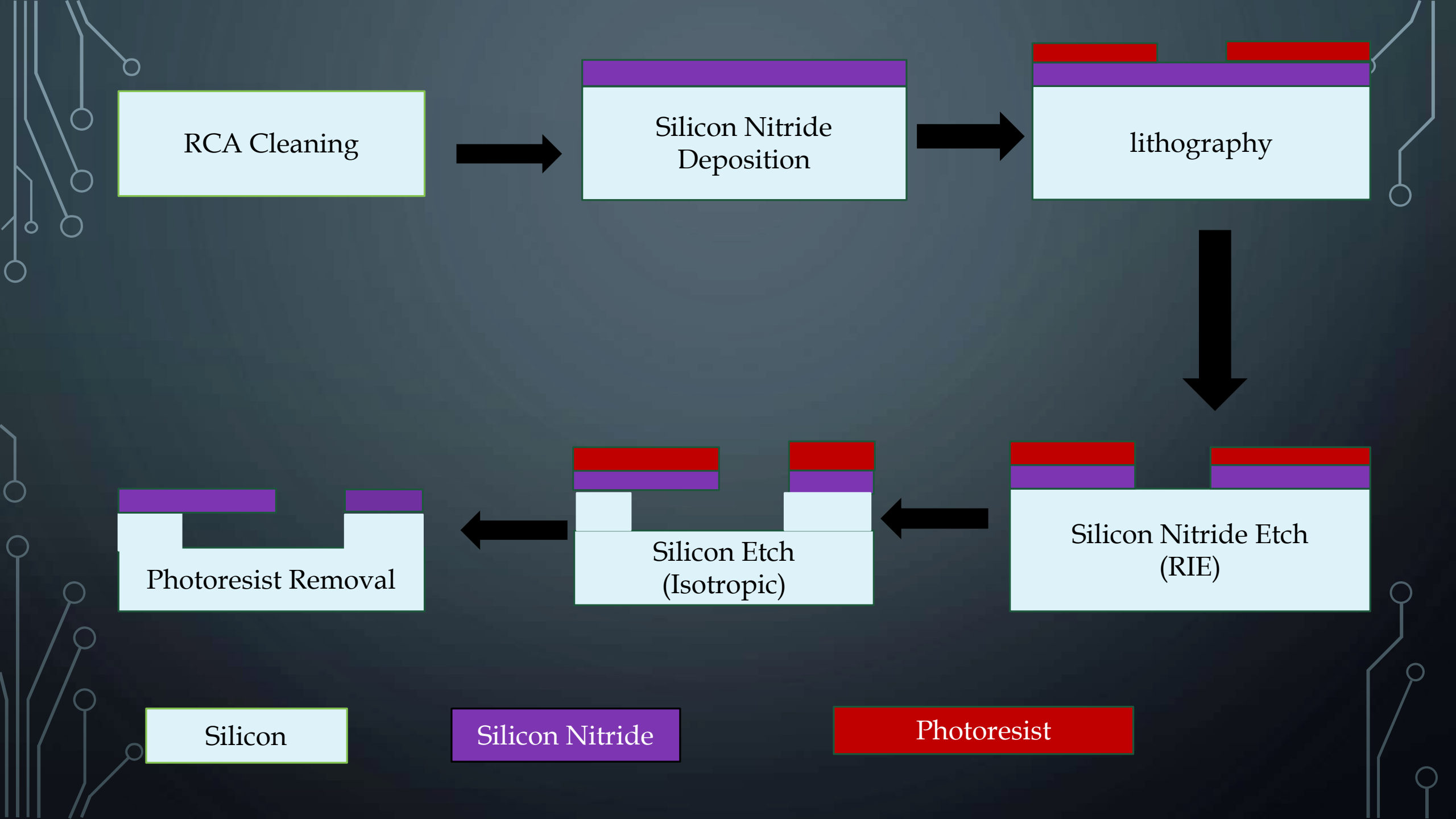
By using a physical vapor deposition (PVD) technique, such as sputtering, we deposit a thin uniform layer of silicon nitride from a target onto the wafer surface.

3. Optical Lithography : Apply a photoresist layer, expose it to UV light through a photomask, and develop the photoresist to create a pattern of the desired cantilever structure on the silicon nitride layer.

4. Silicon Nitride Anisotropic Etch : Use a Reactive ion etching (RIE) process with a gas mixture that preferentially etches silicon nitride layer selectively, forming the cantilever structure.

5. Isotropic Silicon Etch : Use a Dry etch or a Deep reactive ion etching (DRIE) process to etch the silicon substrate isotropically to remove the underlying silicon substrate to release the cantilever.

6. Photoresist Removal : Use a solvent, such as acetone, to Remove the remaining photoresist layer after the fabrication process.


RCA Cleaning
Silicon Nitride Deposition
lithography
Silicon Nitride Etch (RIE)
Silicon Etch (Isotropic)
Photoresist Removal
Silicon
Silicon Nitride
Photoresist

Highlights

- Through the use of PVD, optical lithography, and RIE techniques, silicon nitride MEMS cantilevers were successfully fabricated.
- SEM and AFM analysis showed that the manufactured cantilevers had excellent mechanical properties and surface quality.
- The anisotropic etching process enabled precise control of the cantilever dimensions and shape.
- The isotropic silicon etch effectively released the cantilevers from the substrate.

Conclusion

The fabrication of silicon nitride MEMS cantilevers is a critical step in the development of various micro- and nanoscale devices. This Training Program showed how to successfully fabricate high-quality cantilevers, which could be used in actuators, sensors, and nanomanipulation. Future research could explore further optimizations of the fabrication process, as well as the integration of these cantilevers into more complex systems.

THANK YOU