

**18-322**

# **Lecture 3: Intro to CMOS Process II**

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## **Generic Process Flow for a CMOS Inverter**

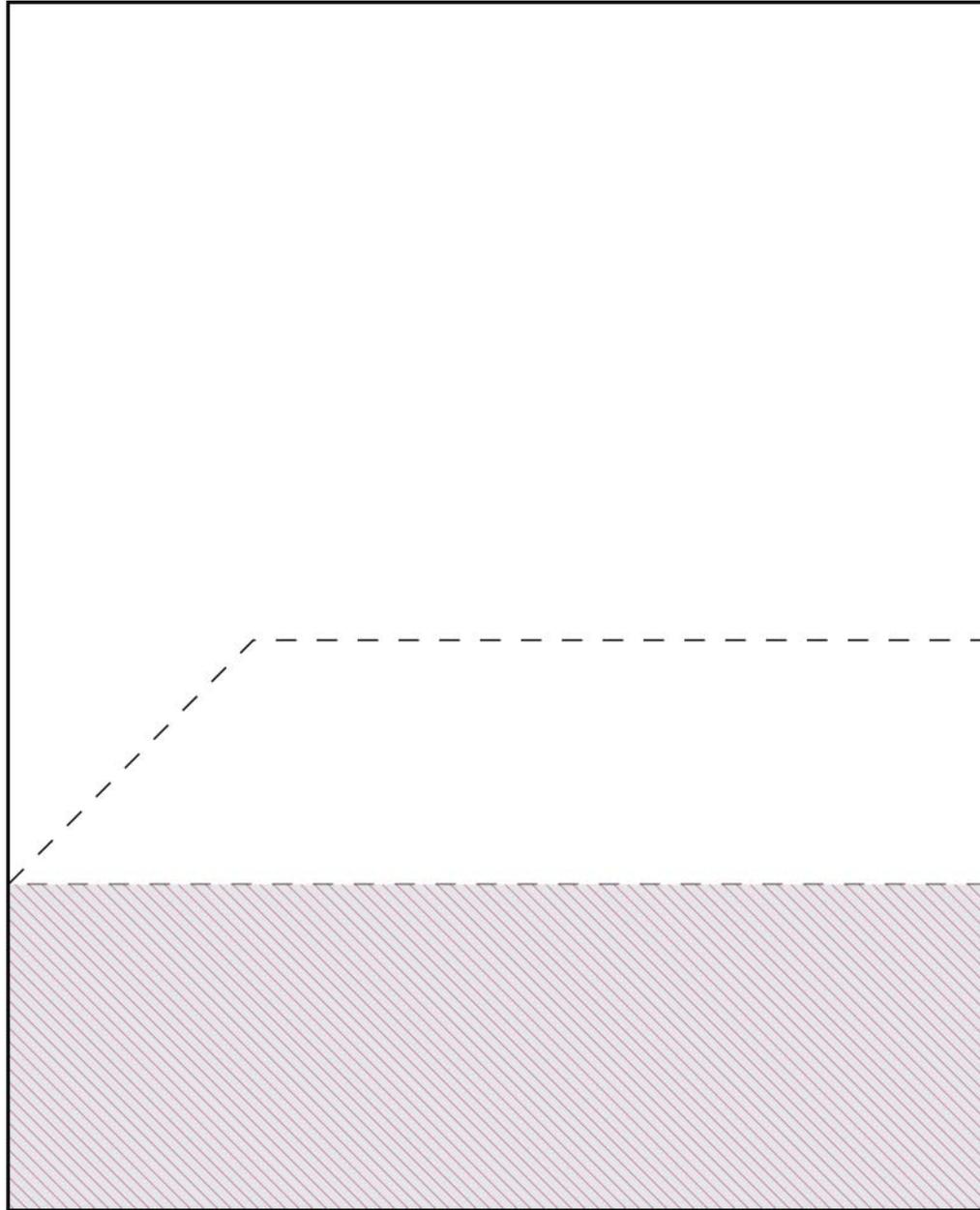
**Readings: Chapter 2**

# Lecture 3 - Outline

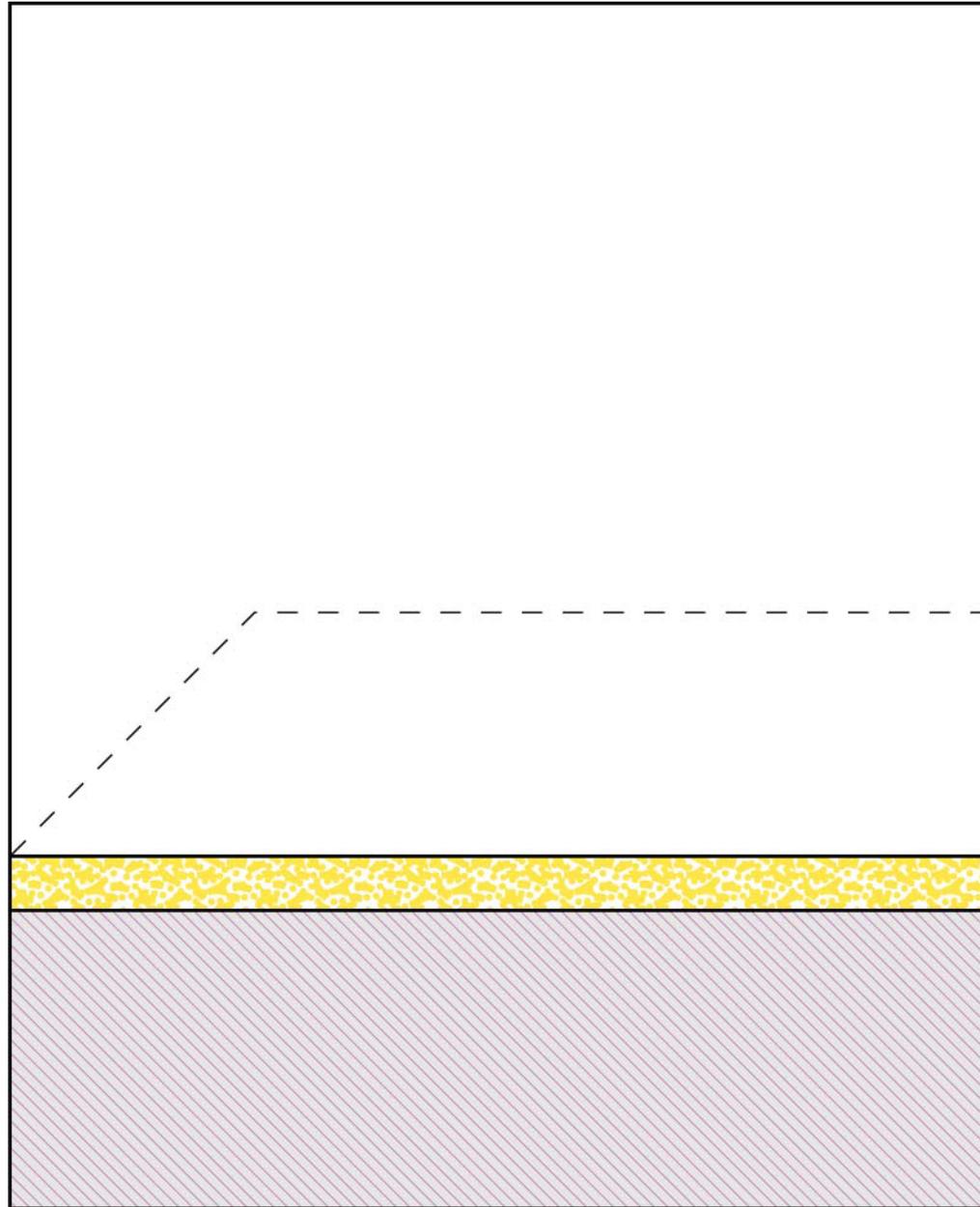
## ☞ **Generic Complimentary Metal-Oxide-Semiconductor (CMOS) Process:**

- ☞ **Processing steps**
- ☞ **N-well process flow**
- ☞ **Lithographic masks**
- ☞ **3-D structures**

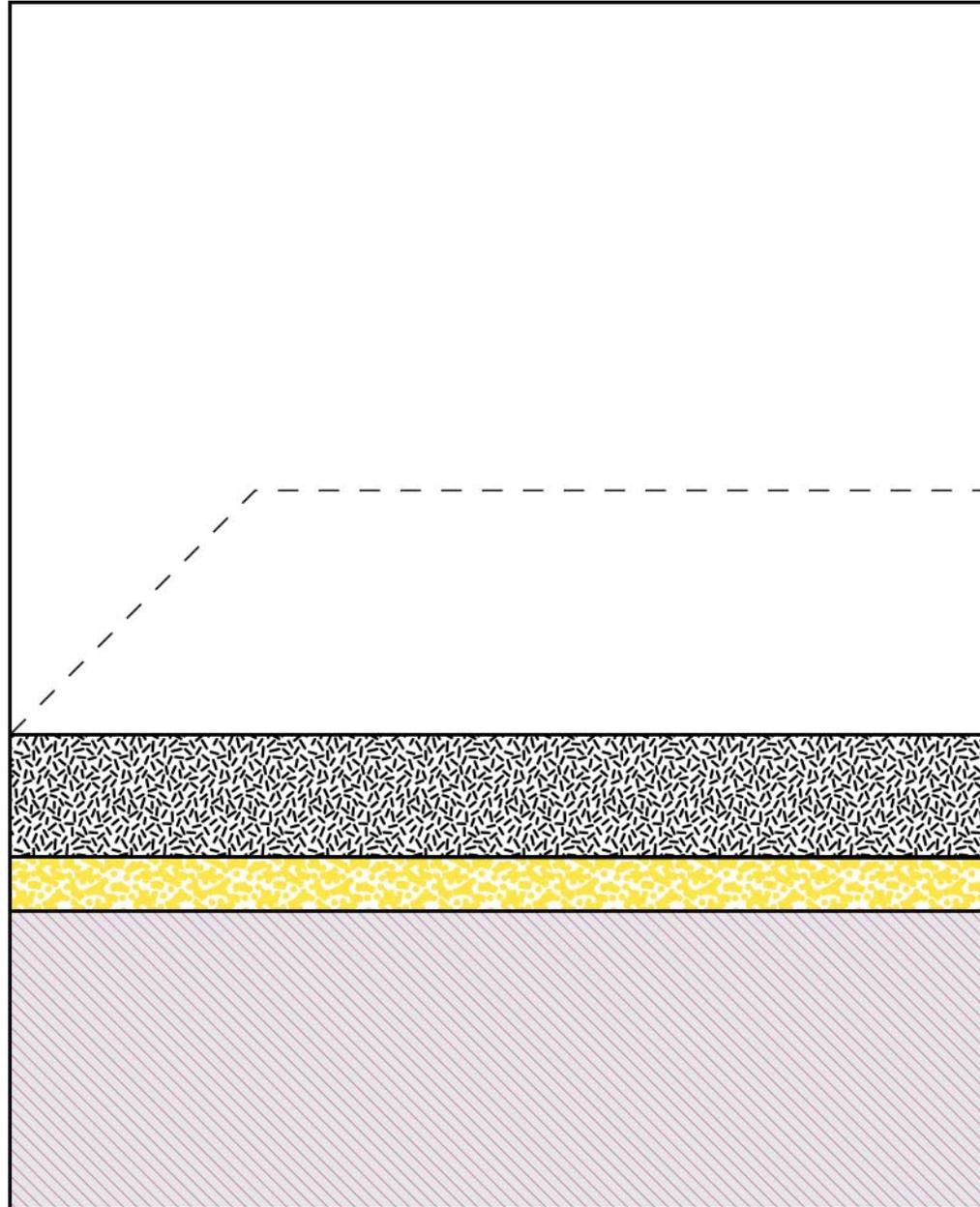
👉 **P- substrate**



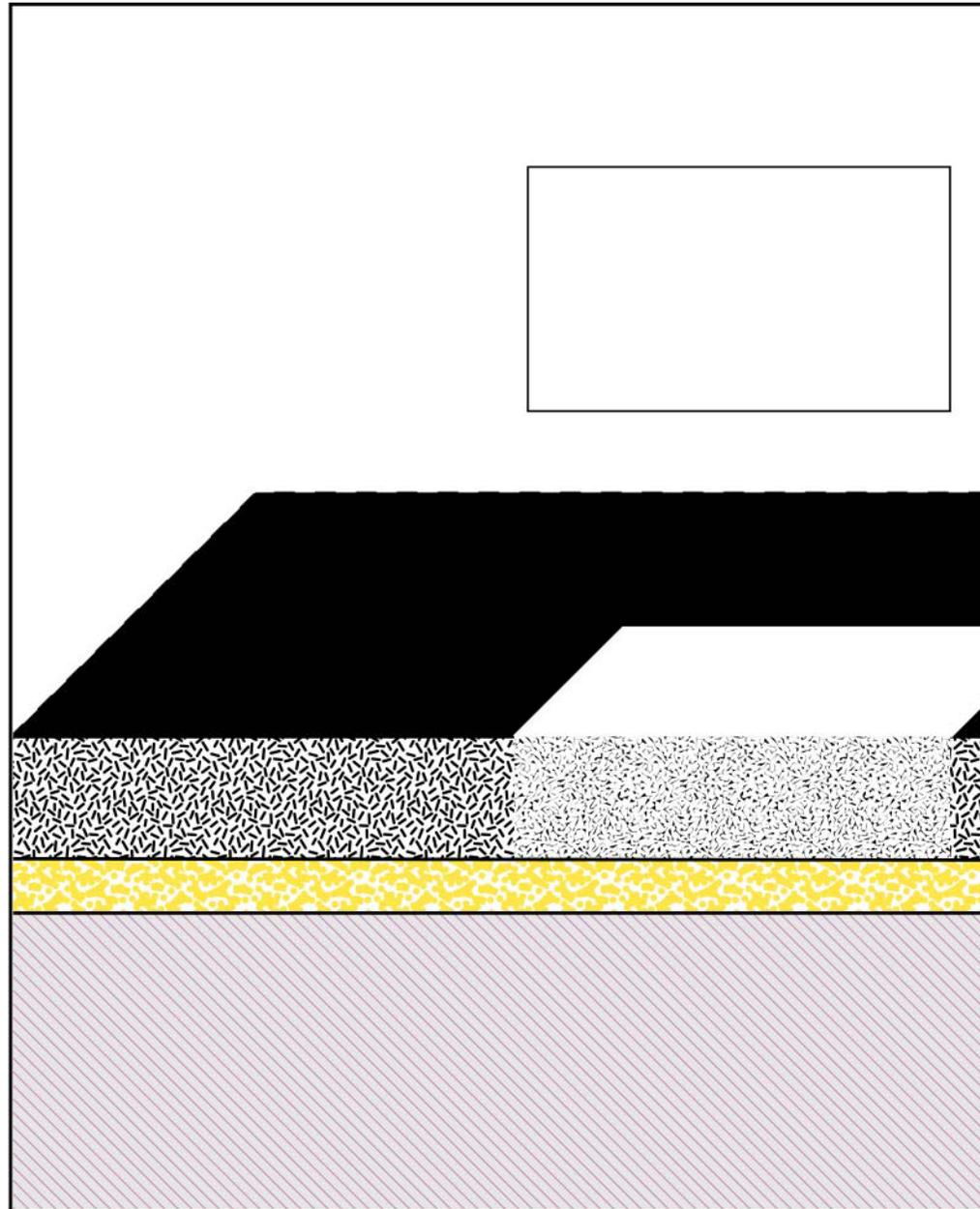
- ➡ **P- substrate;**
- ➡ **Oxidation;**



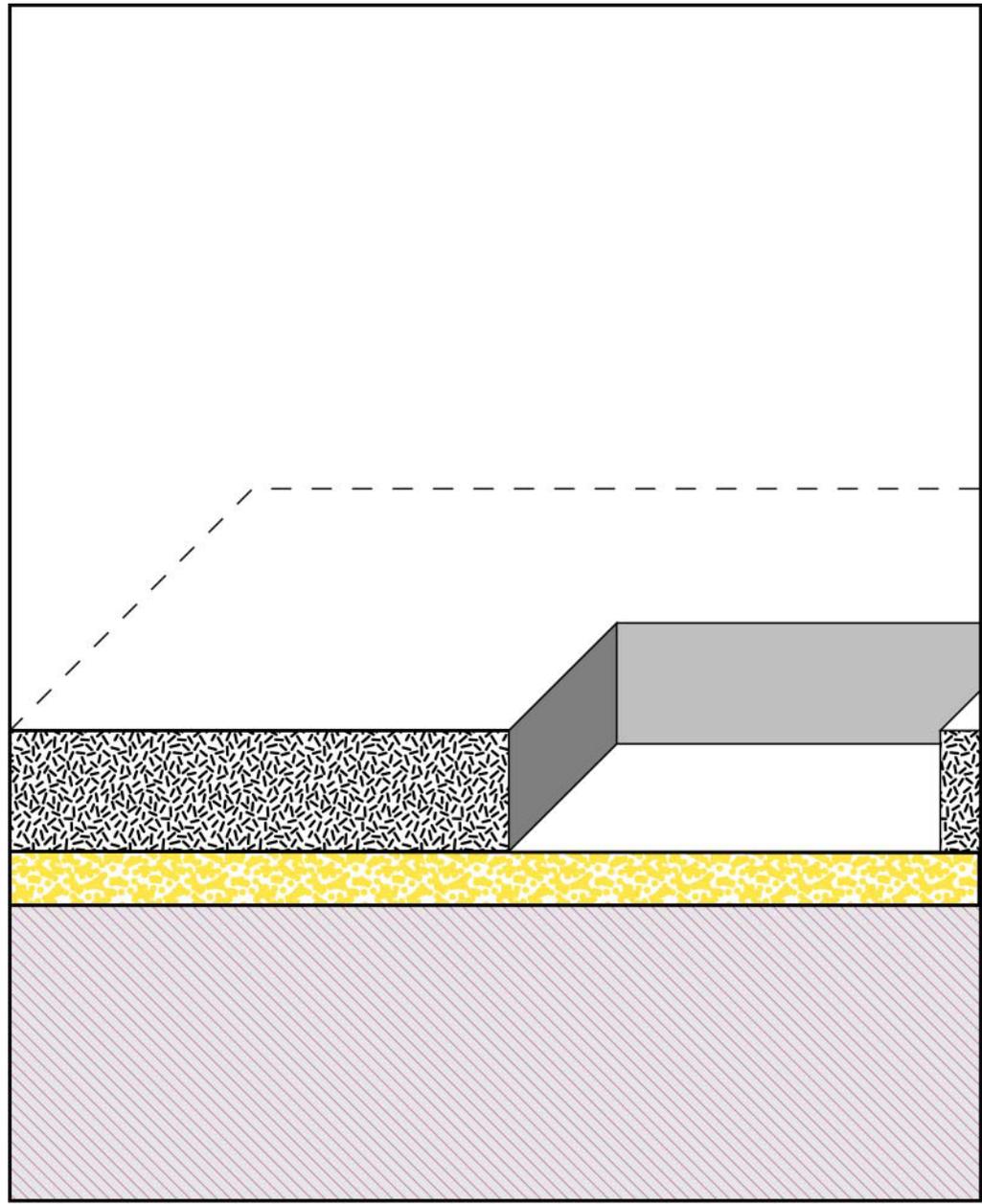
- ➡ **P- substrate;**
- ➡ **Oxidation;**
- ➡ **Photoresist deposition;**



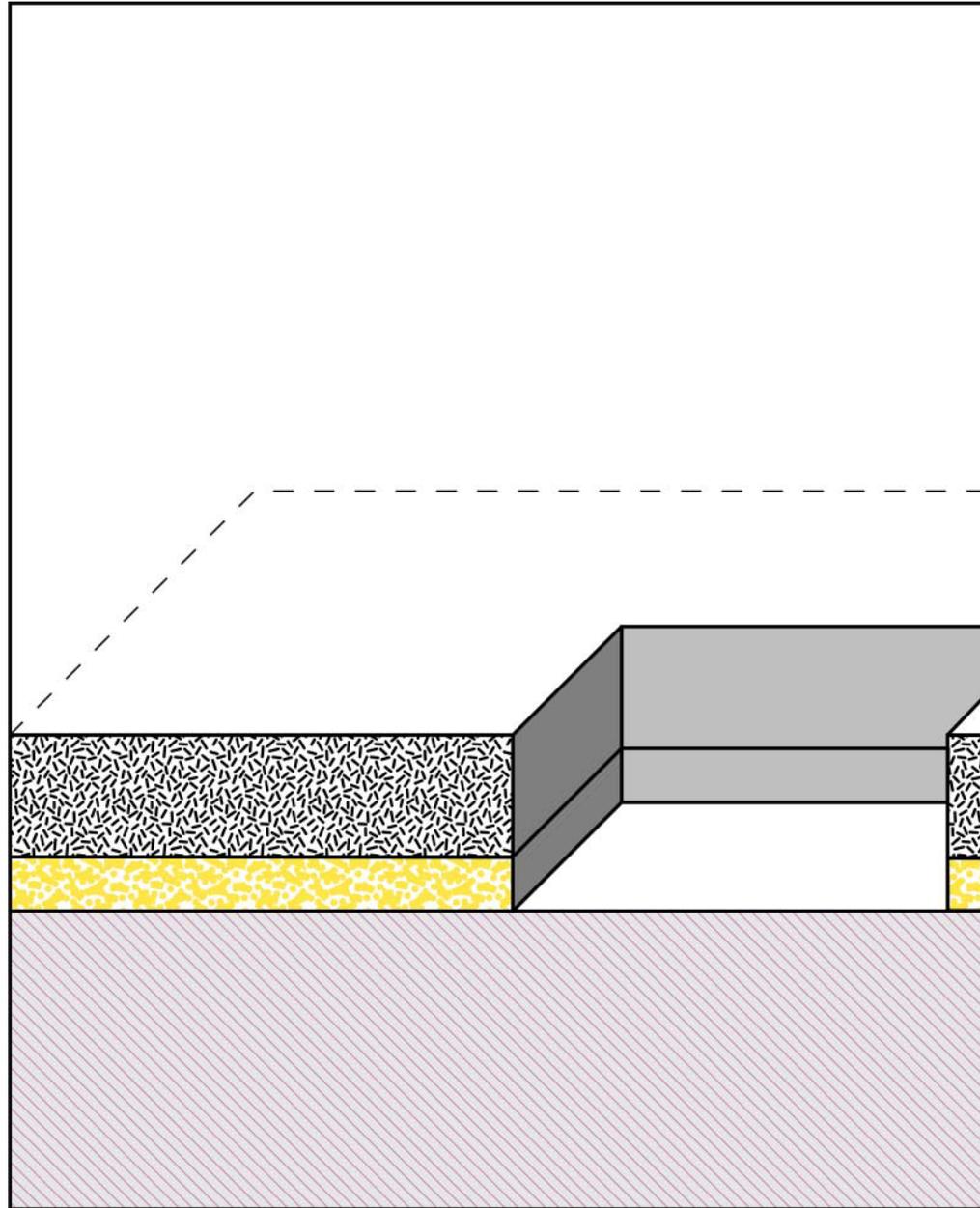
- ➡ **P- substrate;**
- ➡ **Oxidation;**
- ➡ **Photoresist deposition;**
- ➡ **Exposure;**



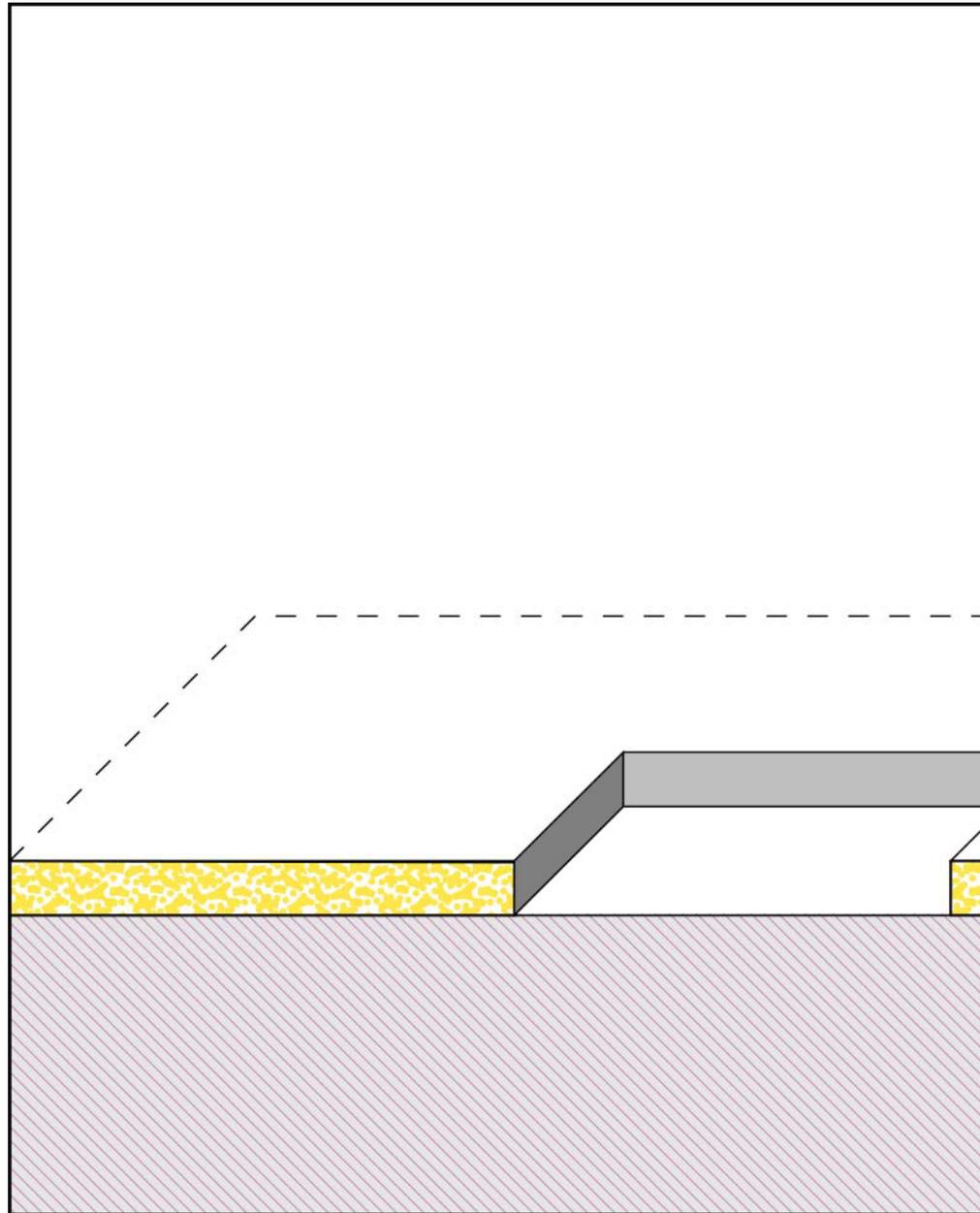
- ➡ **P- substrate;**
- ➡ **Oxidation;**
- ➡ **Photoresist deposition;**
- ➡ **Exposure;**
- ➡ **Development;**
- ➡ **Baking;**



- **P- substrate;**
- **Oxidation;**
- **Photoresist deposition;**
- **Exposure;**
- **Development;**
- **Baking;**
- **Etching;**



- **P- substrate;**
- **Oxidation;**
- **Photo-resist deposition;**
- **Exposure;**
- **Development;**
- **Baking;**
- **Etching;**
- **Photo-resist strip;**
- **Cleaning**



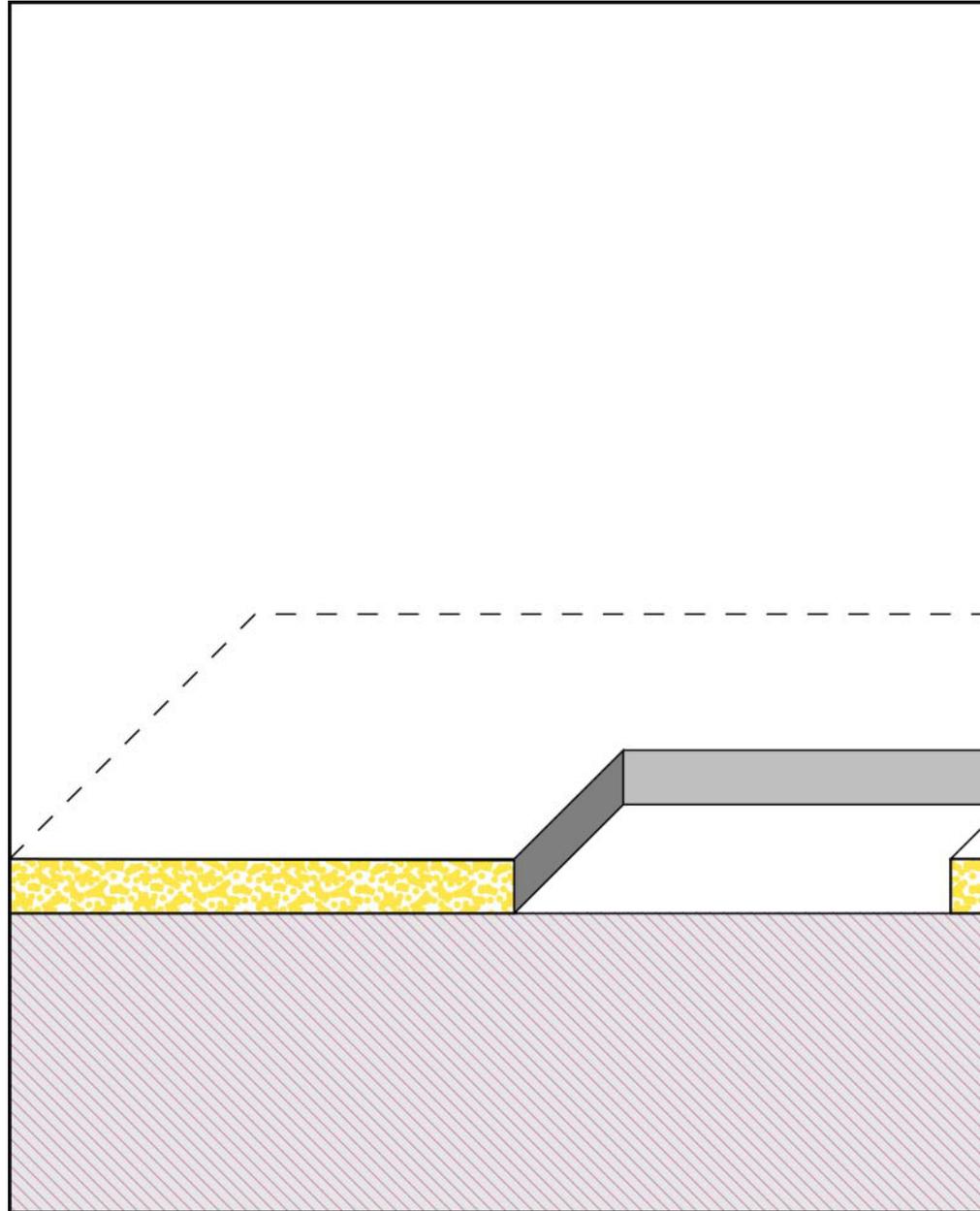
➔ **P- substrate;**

➔ **Oxidation;**

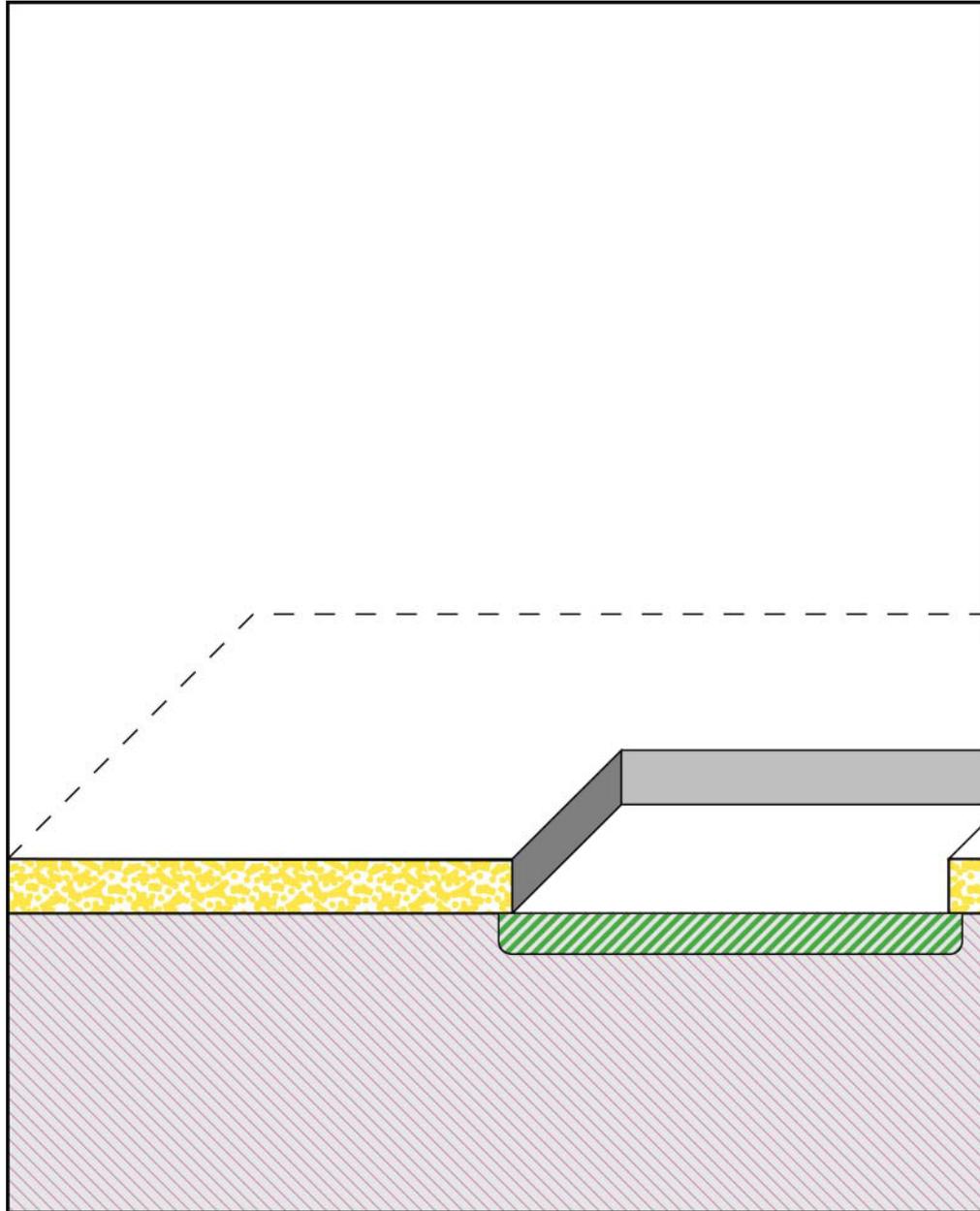
➔ **Well -**

**lithography:**

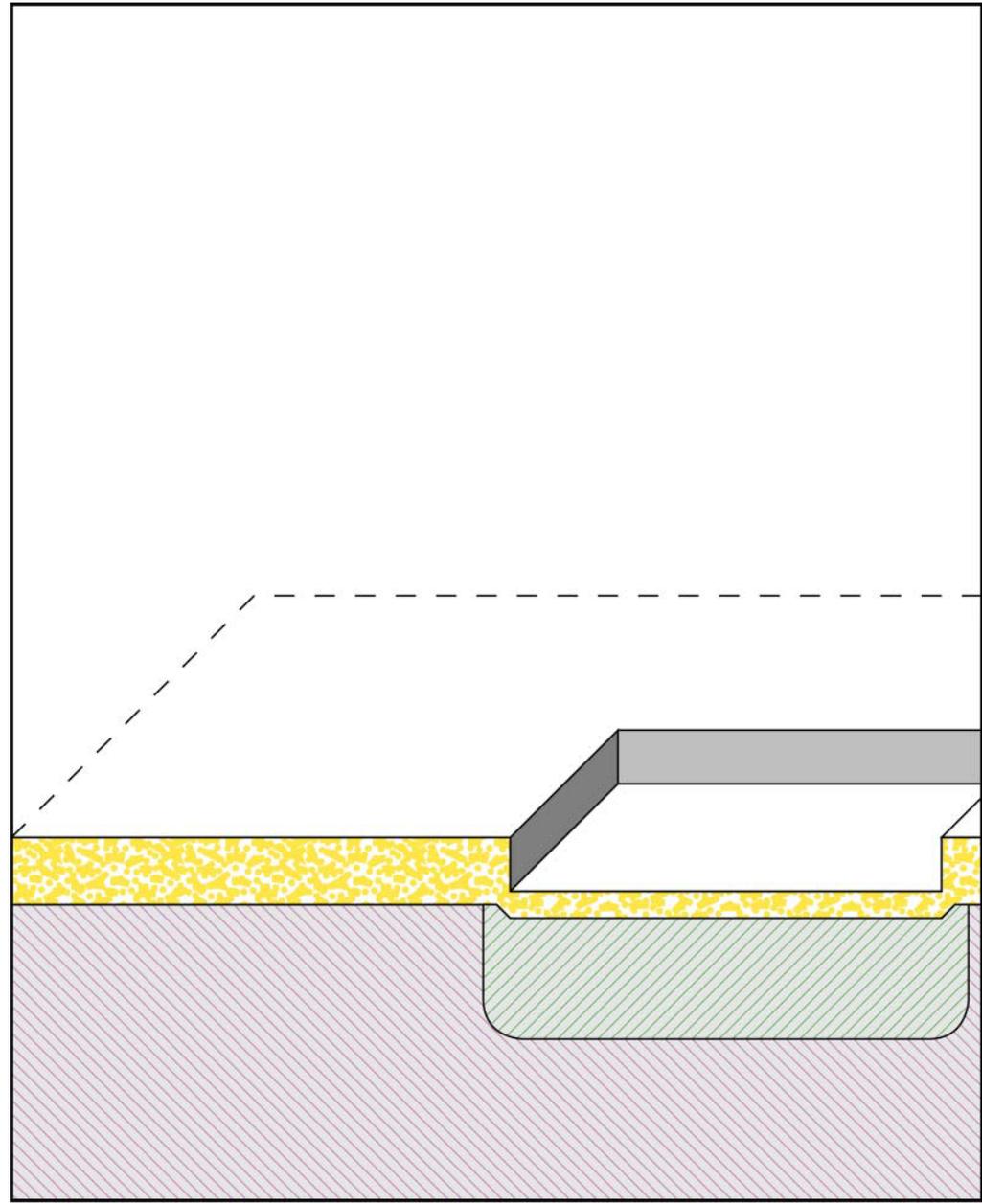
- ➔ **Photo-resist deposition;**
- ➔ **Exposure;**
- ➔ **Development;**
- ➔ **Baking;**
- ➔ **Etching;**
- ➔ **Photo-resist strip;**
- ➔ **Cleaning.**



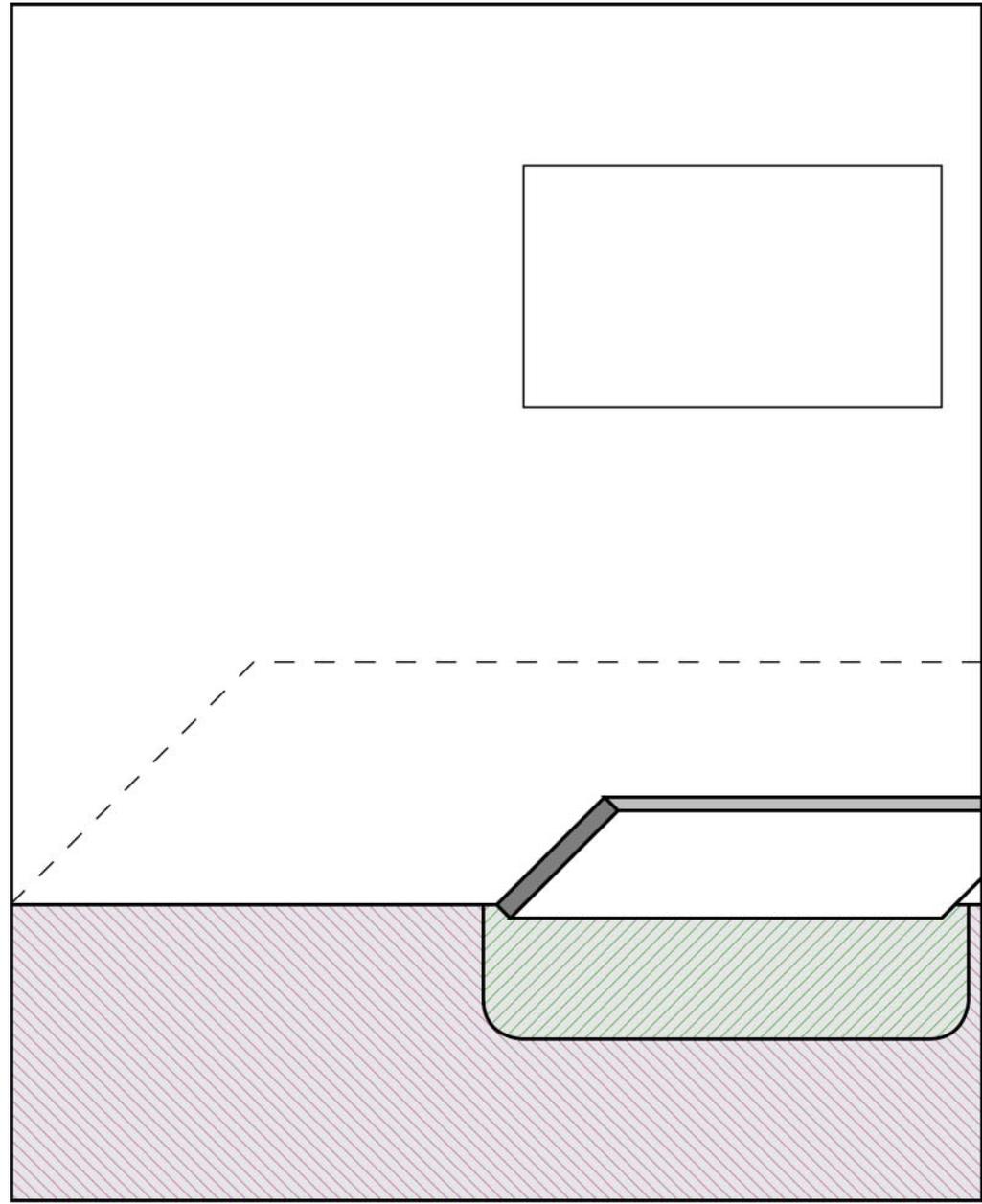
- **P- substrate;**
- **Oxidation;**
- **Well - lithography:**
- **N-well pre-diffusion (Arsenic);**



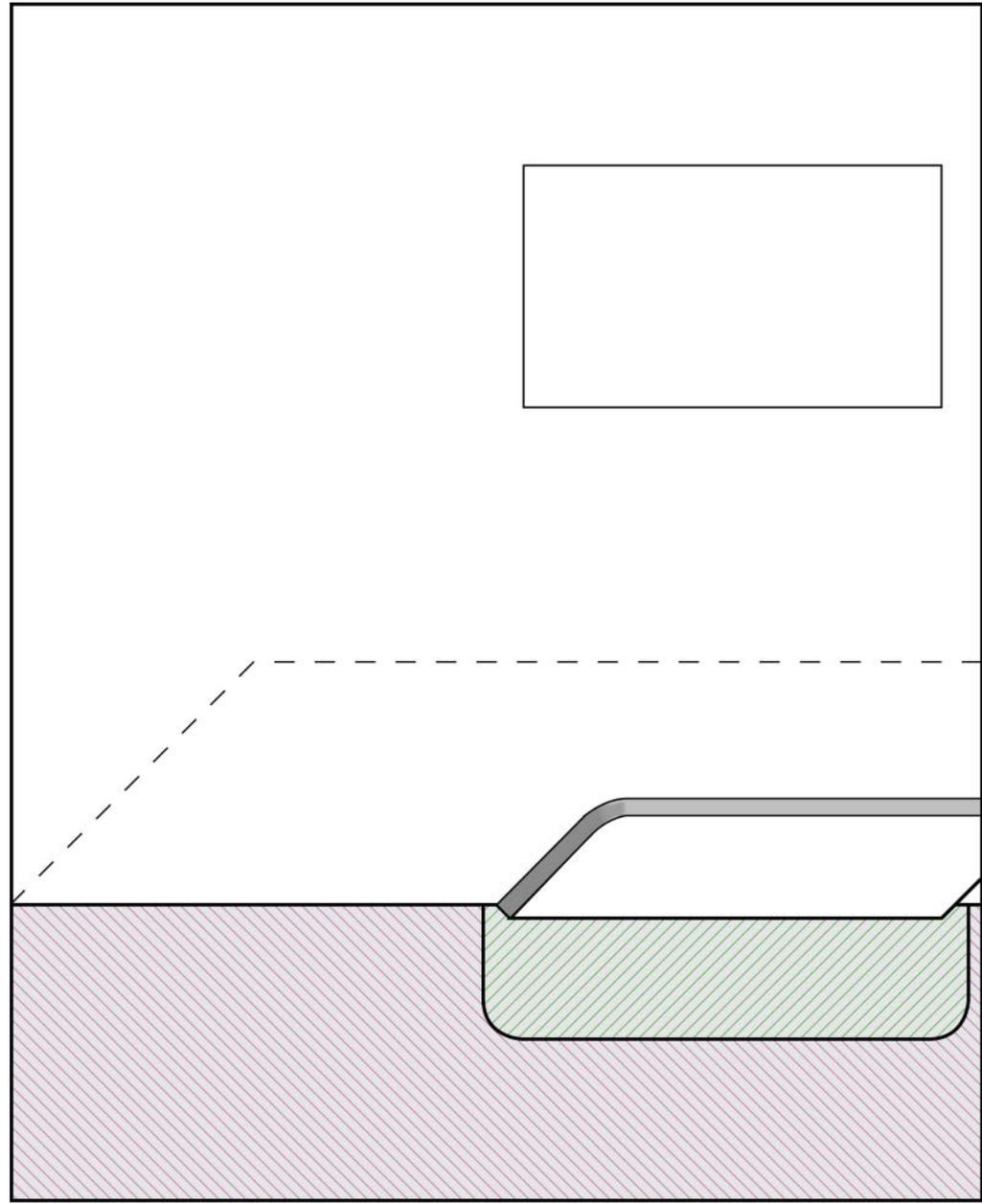
- **P- substrate;**
- **Oxidation;**
- **Well - lithography:**
- **N-well pre-diffusion (Arsenic);**
- **Well drive-in;**



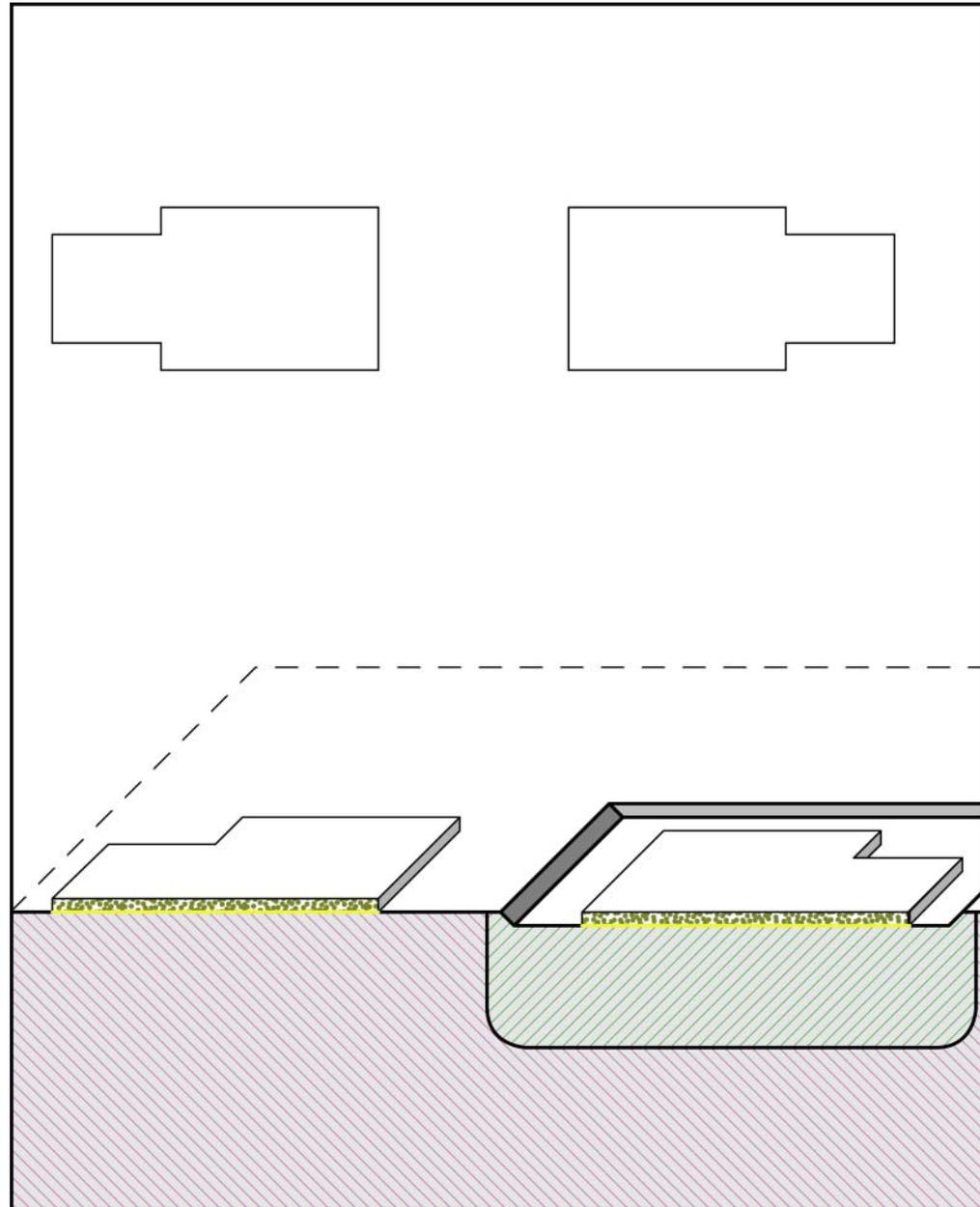
- **P- substrate;**
- **Oxidation;**
- **Well - lithography:**
- **N-well pre-diffusion;**
- **Well drive-in;**
- **Oxide removal**



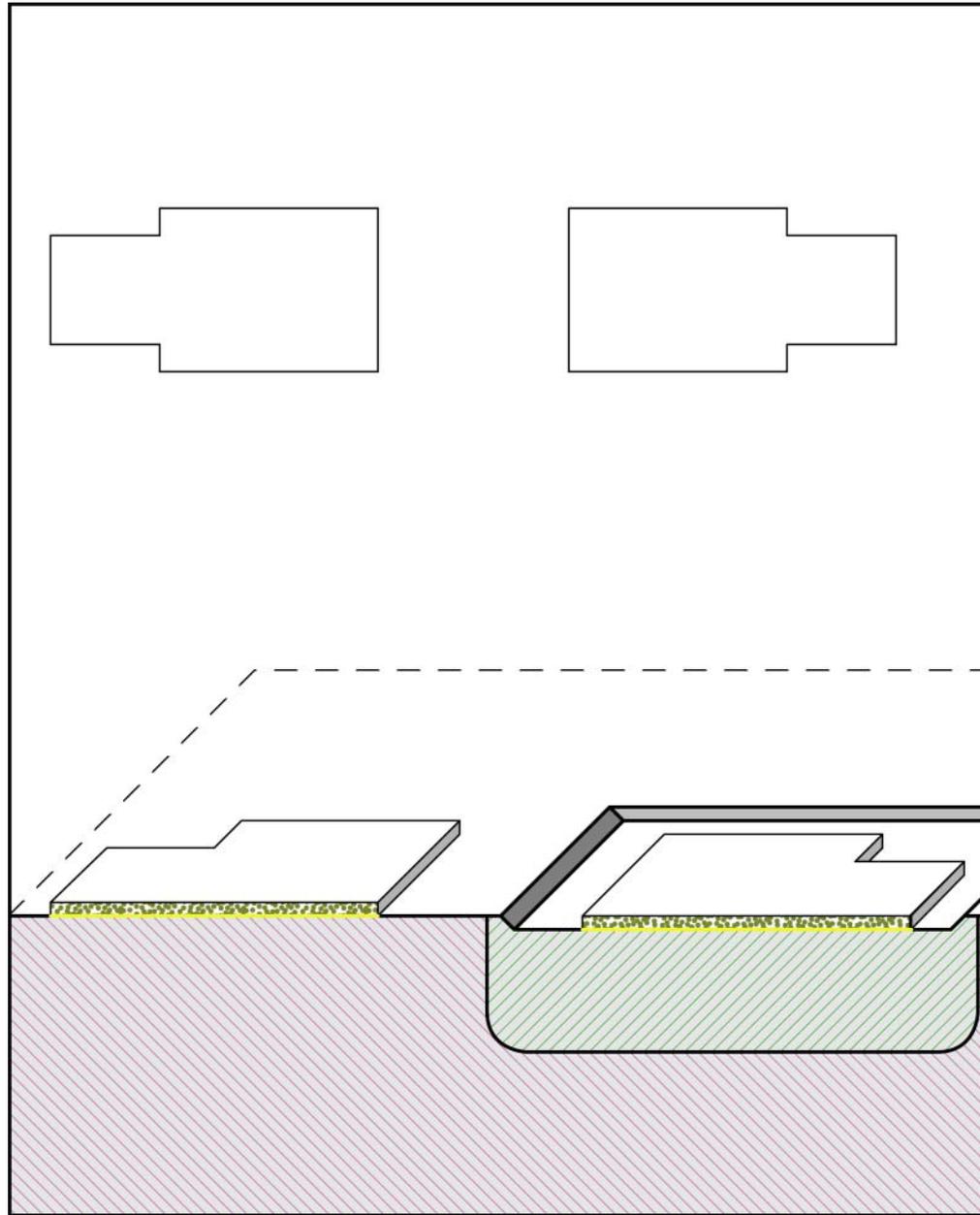
- ➡ **P- substrate;**
- ➡ **Oxidation;**
- ➡ **Well - lithography:**
- ➡ **N-well pre-diffusion;**
- ➡ **Well drive-in;**
- ➡ **Oxide rm.**



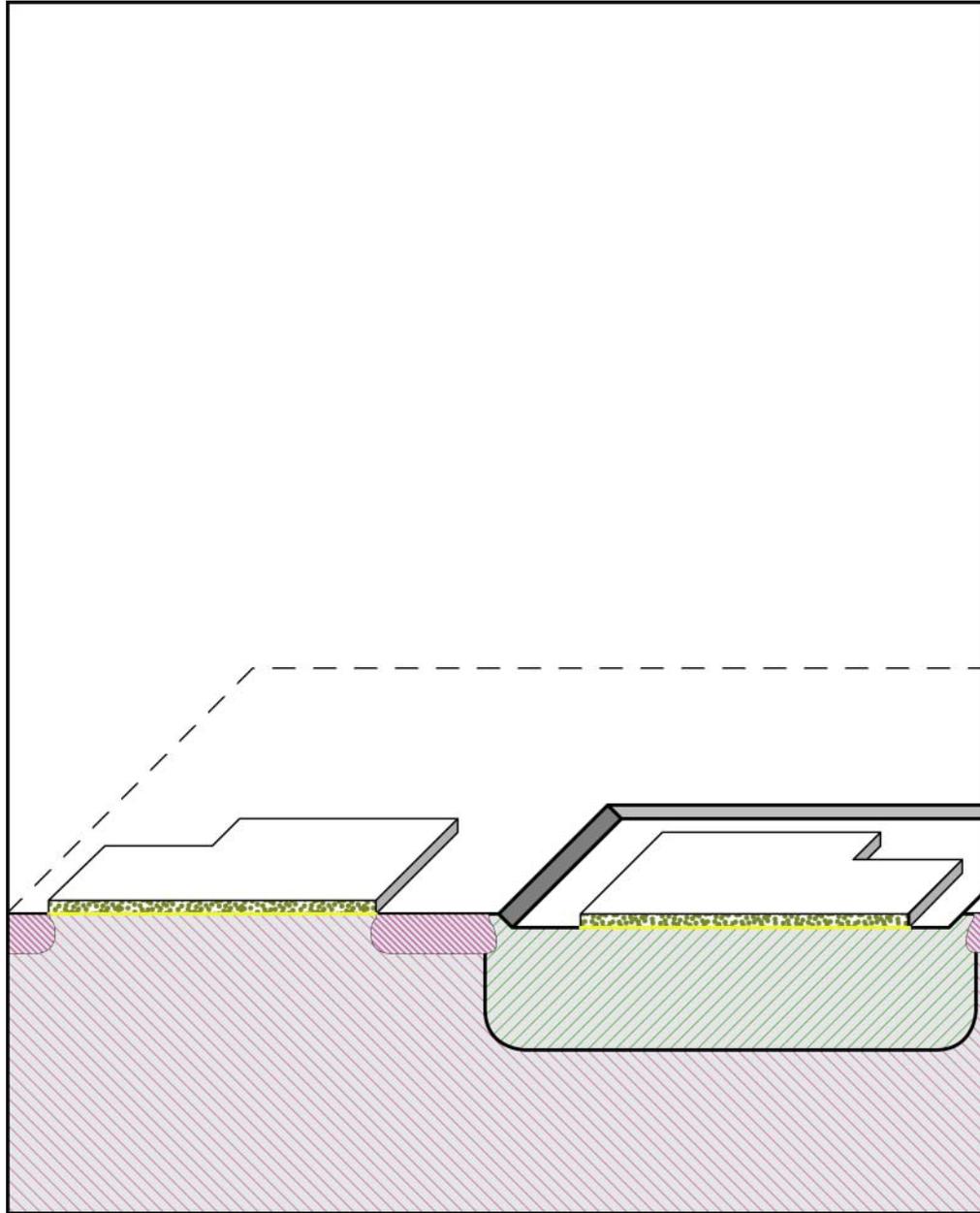
- **Well - lithography:**
- **N-well pre-diffusion;**
- **Well drive-in;**
- **Oxide rm.**
- **Oxidation**
- **Nitride deposition;**
- **Active litho.**



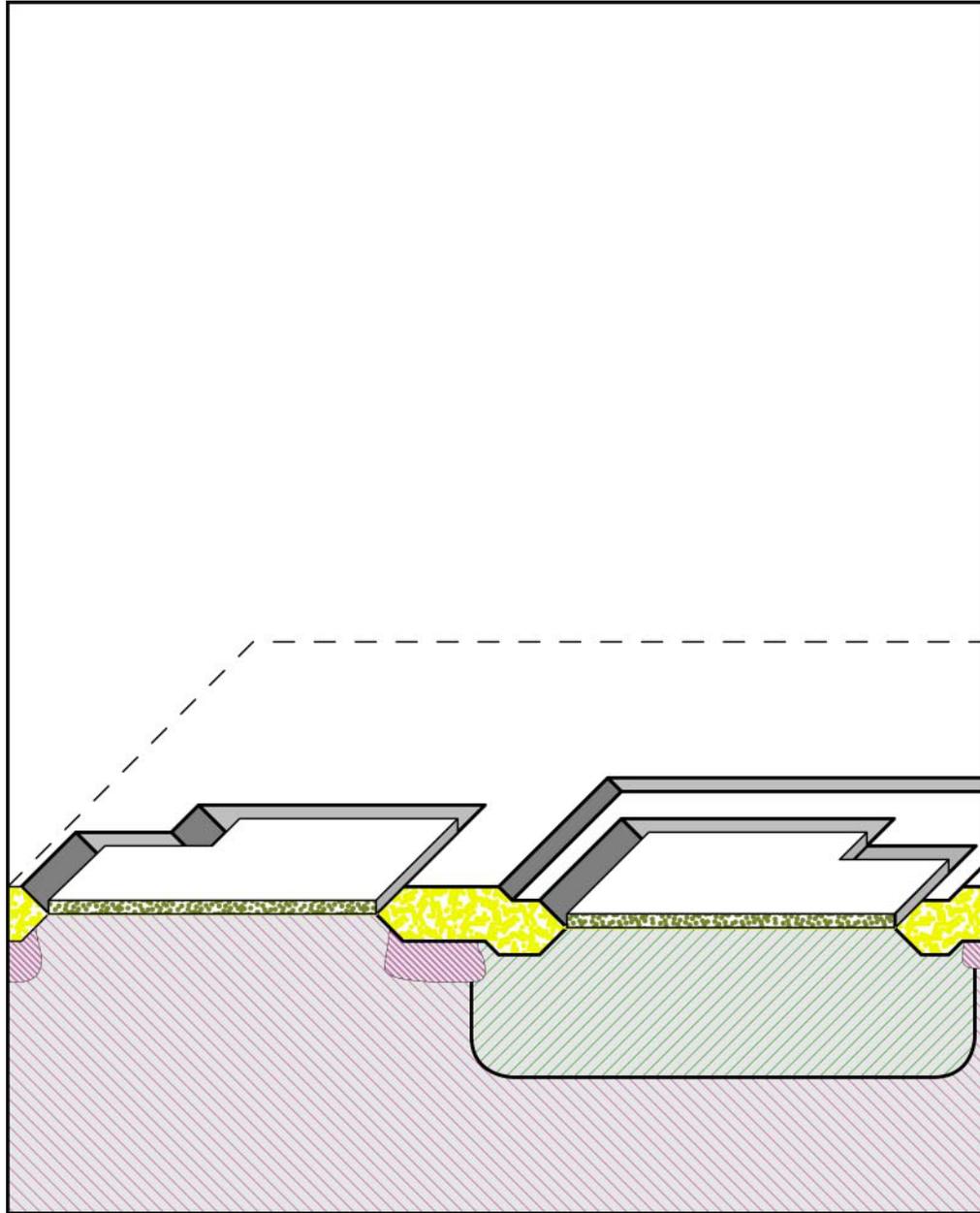
- **Oxidation;**
- **Nitride deposition;**
- **Active litho.**
  - **Photo-resist deposition;**
  - **Exposure;**
  - **Development;**
  - **Baking;**
  - **Etching;**
  - **Photo-resist strip;**
  - **Cleaning**



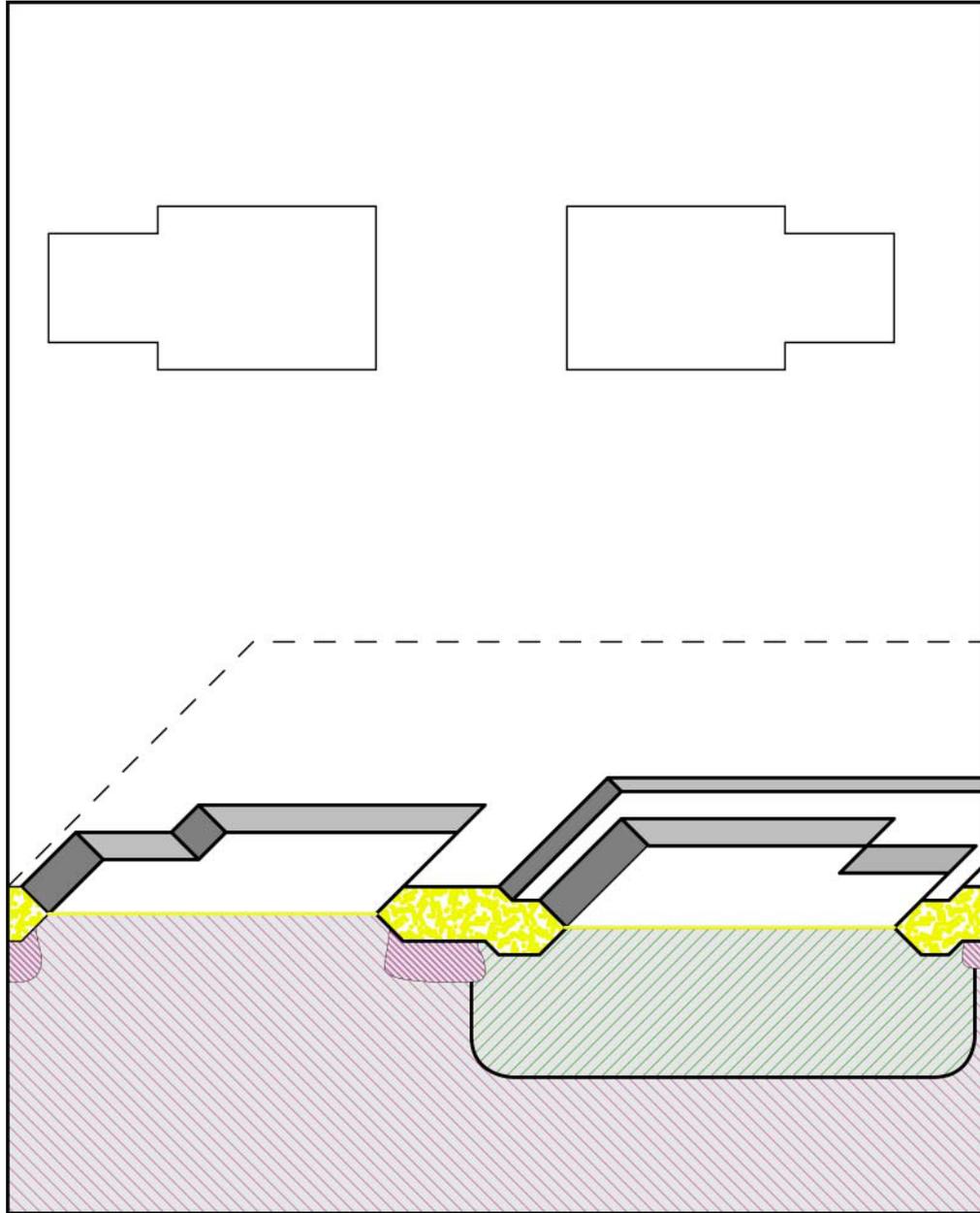
- ➔ **Nitride deposition;**
- ➔ **Active litho.**
- ➔ **Channel-stop implantation;**



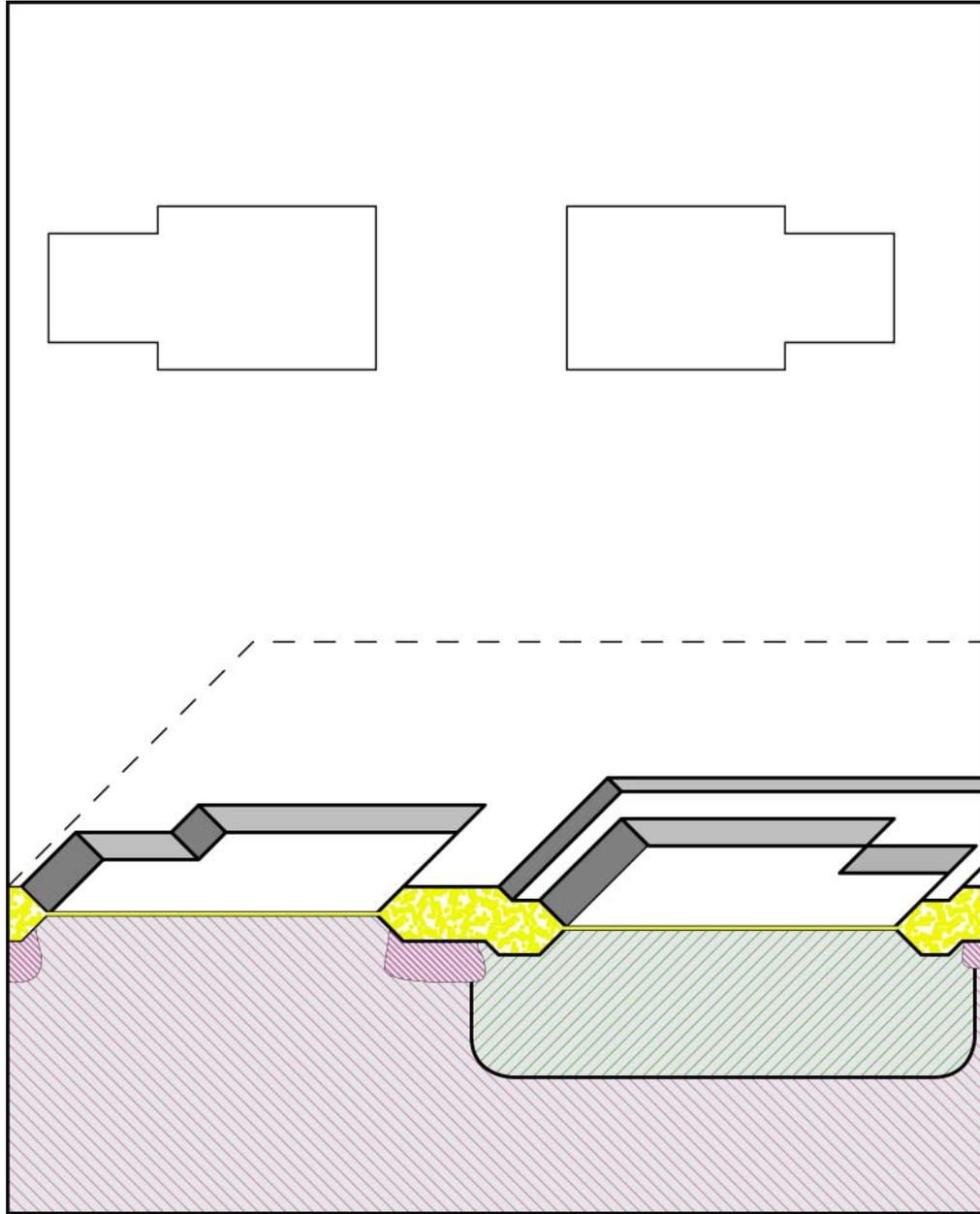
- Nitride deposition;
- Active litho.
- Channel-stop implantation;
- Field oxidation (FOX)



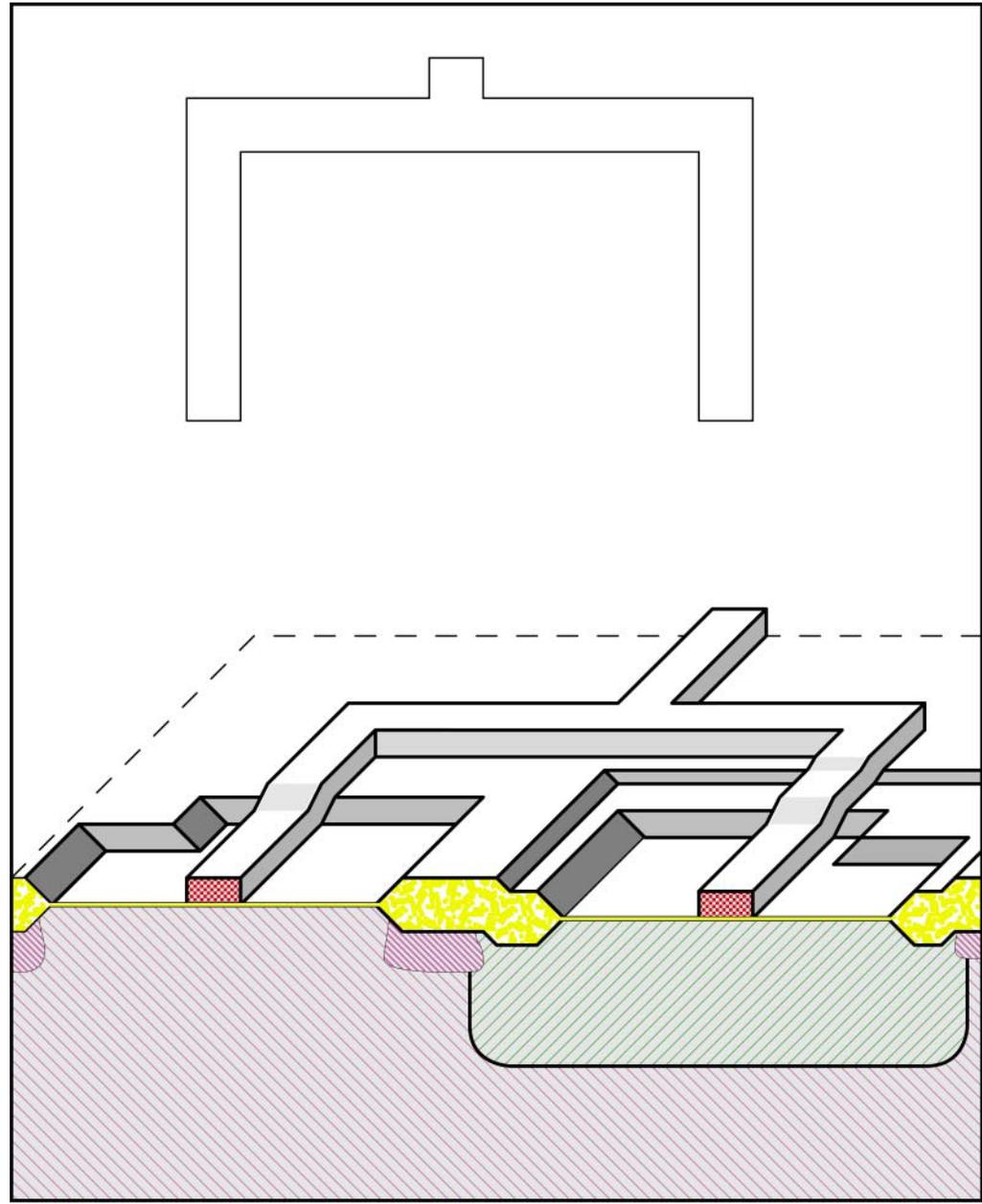
- **Nitride deposition;**
- **Active litho.**
- **Channel-stop implantation;**
- **Field oxidation;**
- **Nitride rm.;**
- **Oxide rm.;**
- **Cleaning;**



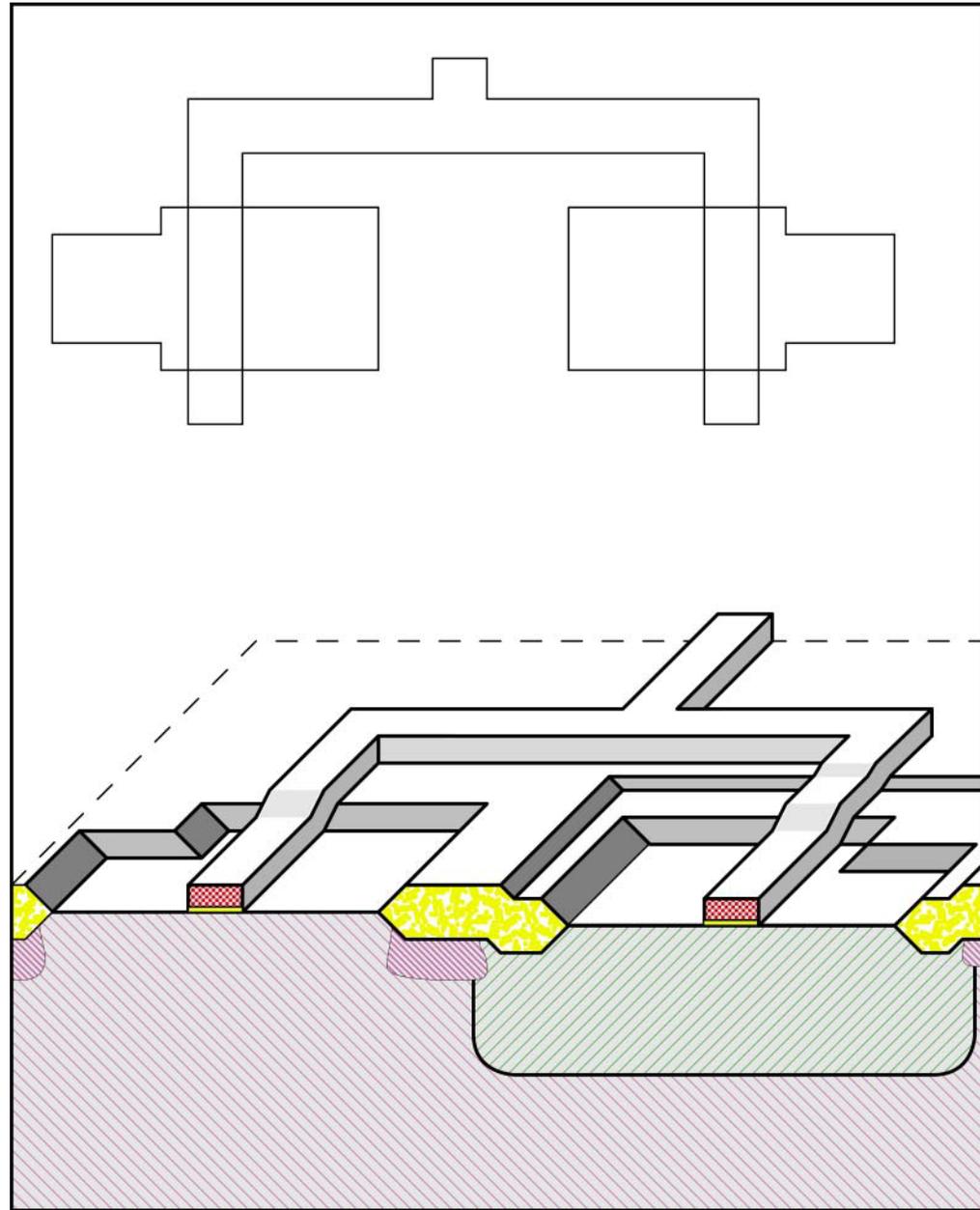
- Nitride deposition;
- Active litho.
- Channel-stop implantation;
- Field oxidation;
- Nitride rm.;
- Oxide rm.;
- Cleaning;
- Gate oxidation (GOX);



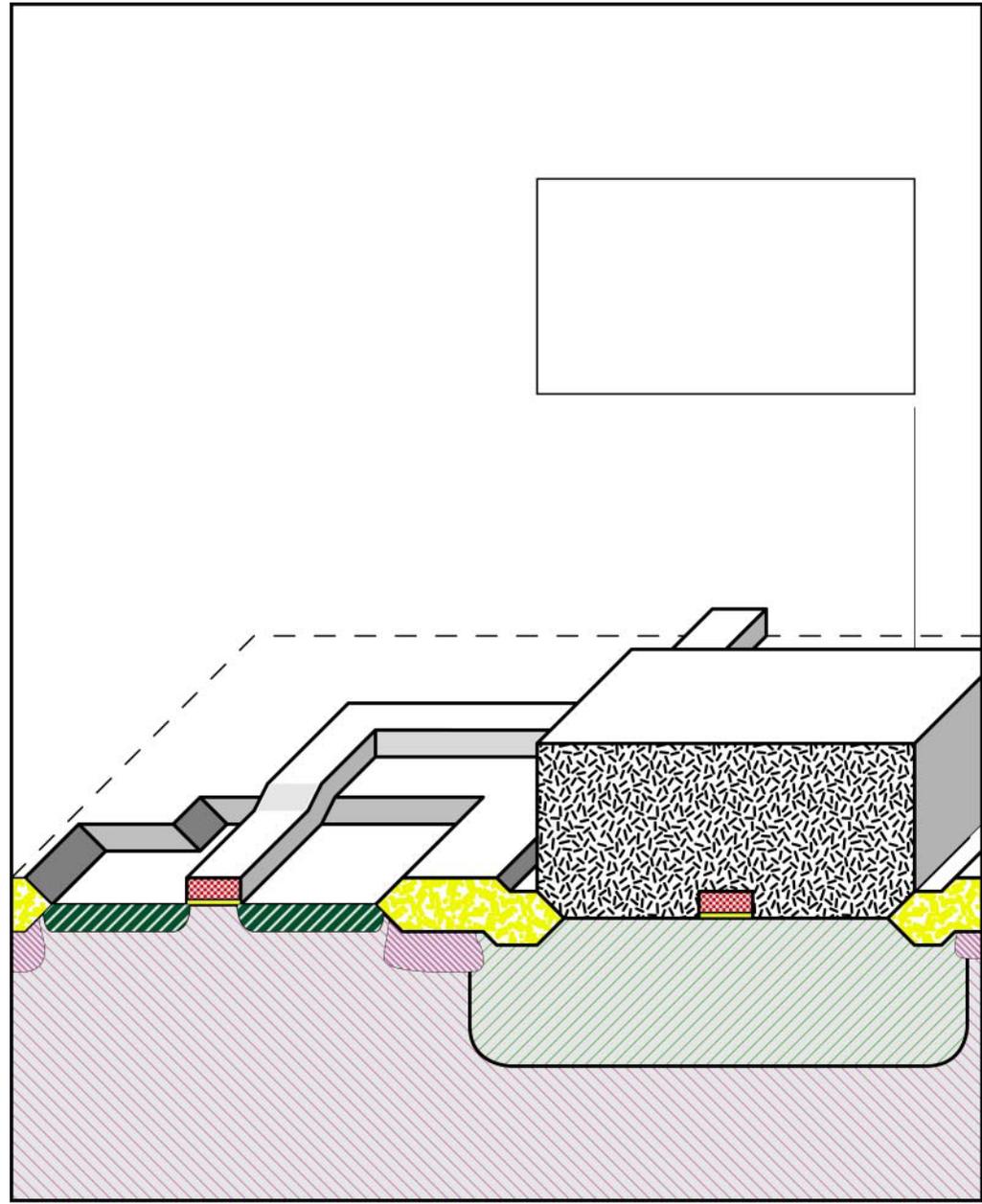
- ➔ Gate oxidation (GOX);
- ➔ Polysilicon (poly) deposition;
- ➔ Poly litho;



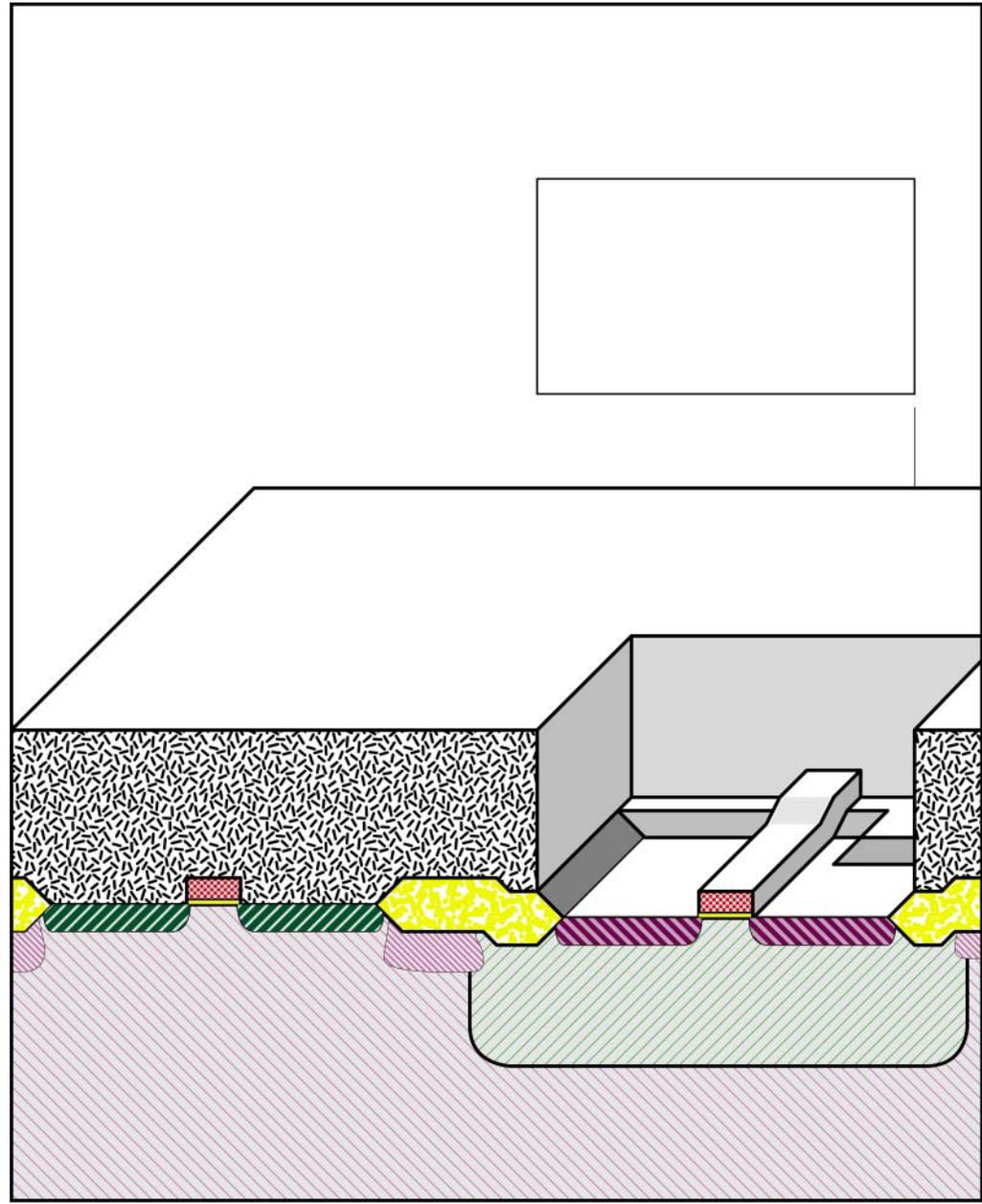
- Gate oxidation (GOX);
- Polysilicon (poly) deposition;
- Poly litho;
- GOX oxide rm.



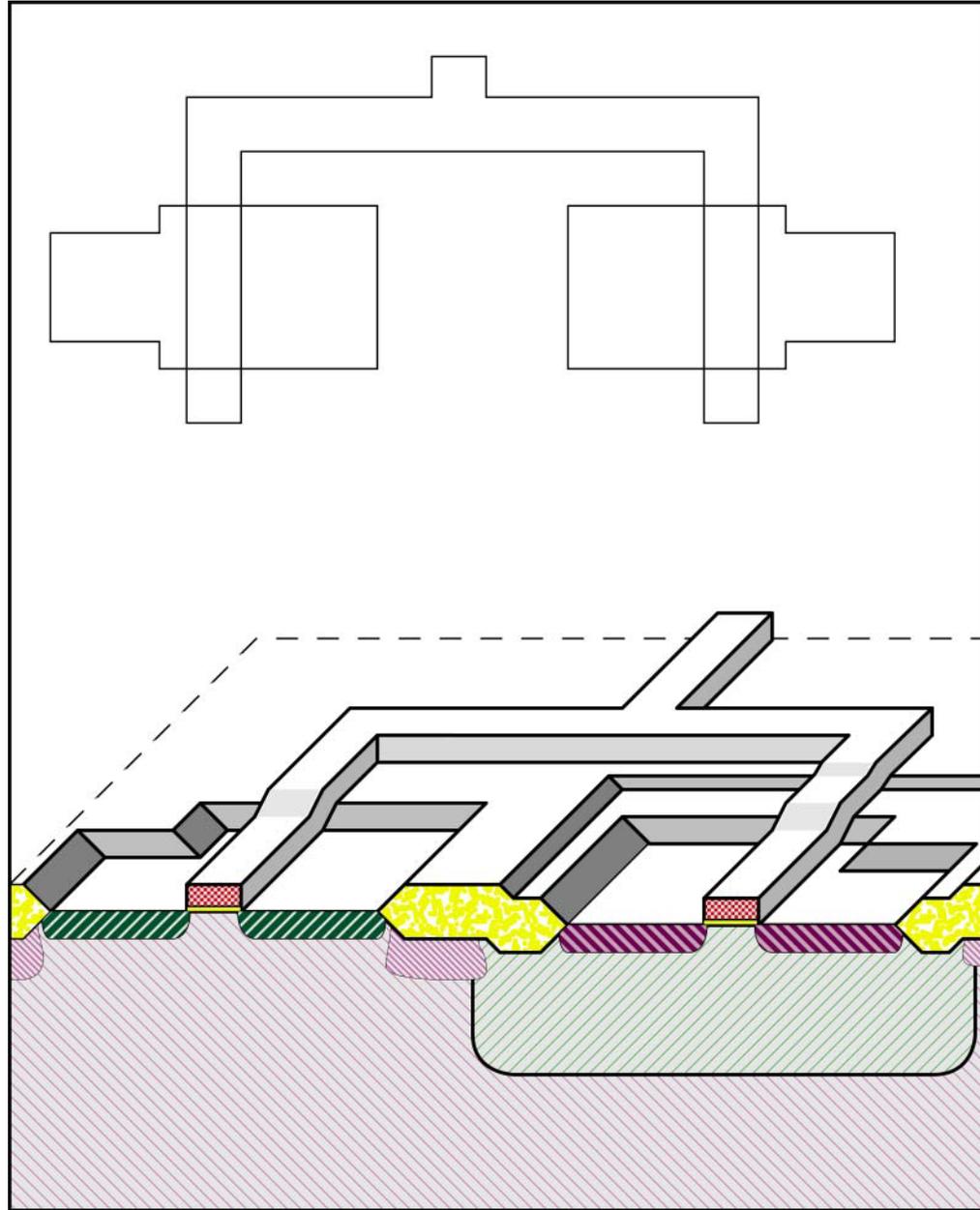
- Gate oxidation (GOX);
- Polysilicon (poly) deposition;
- Poly litho;
- N litho;
- Negative pr.
- N (Phosphorus) implantation.



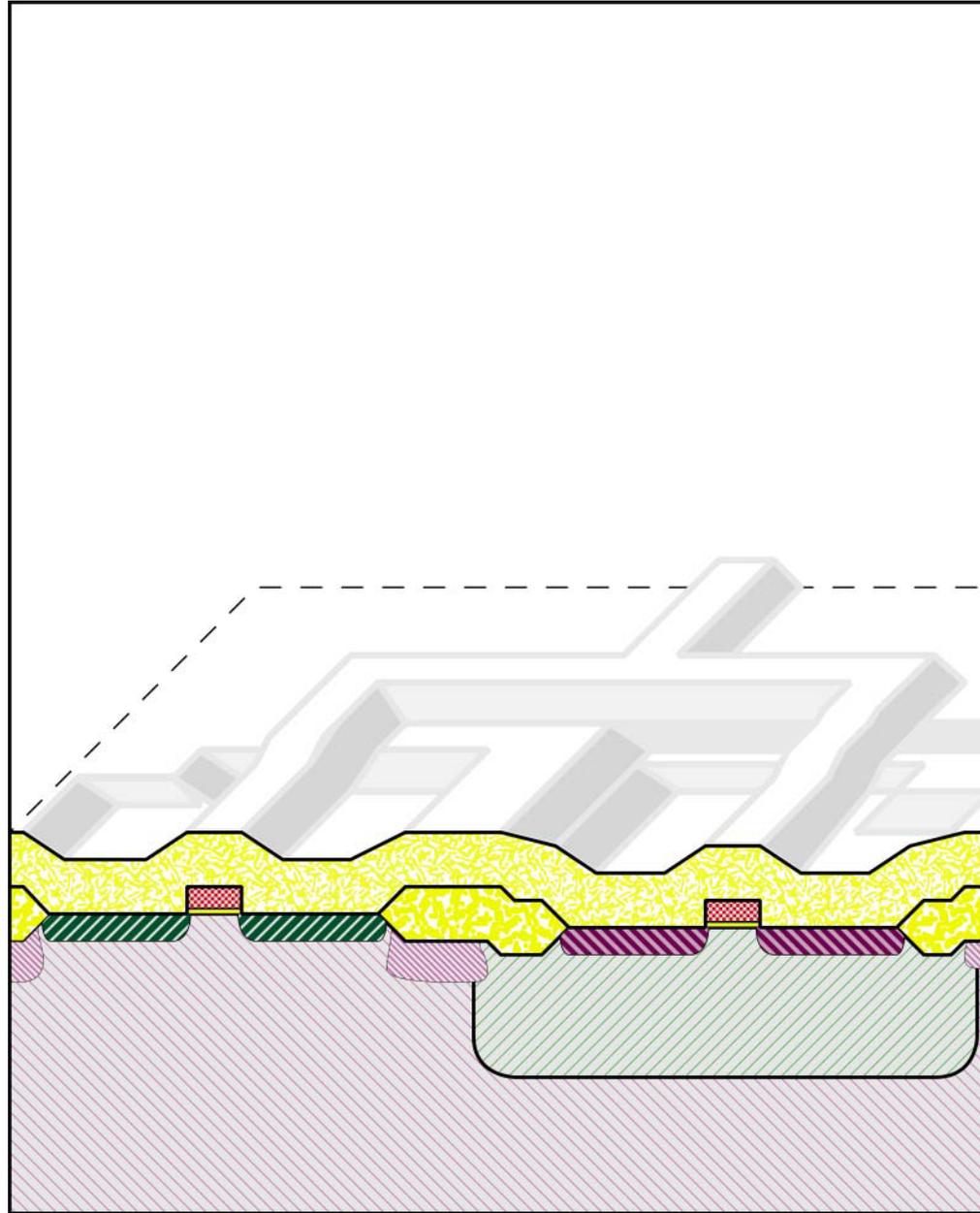
- ➡ **Poly litho;**
- ➡ **N litho;**
  - ➡ Negative pr.
  - ➡ N (Phosphorus) implantation.
- ➡ **P litho;**
  - ➡ Positive pr.
  - ➡ P (Boron) implantation.



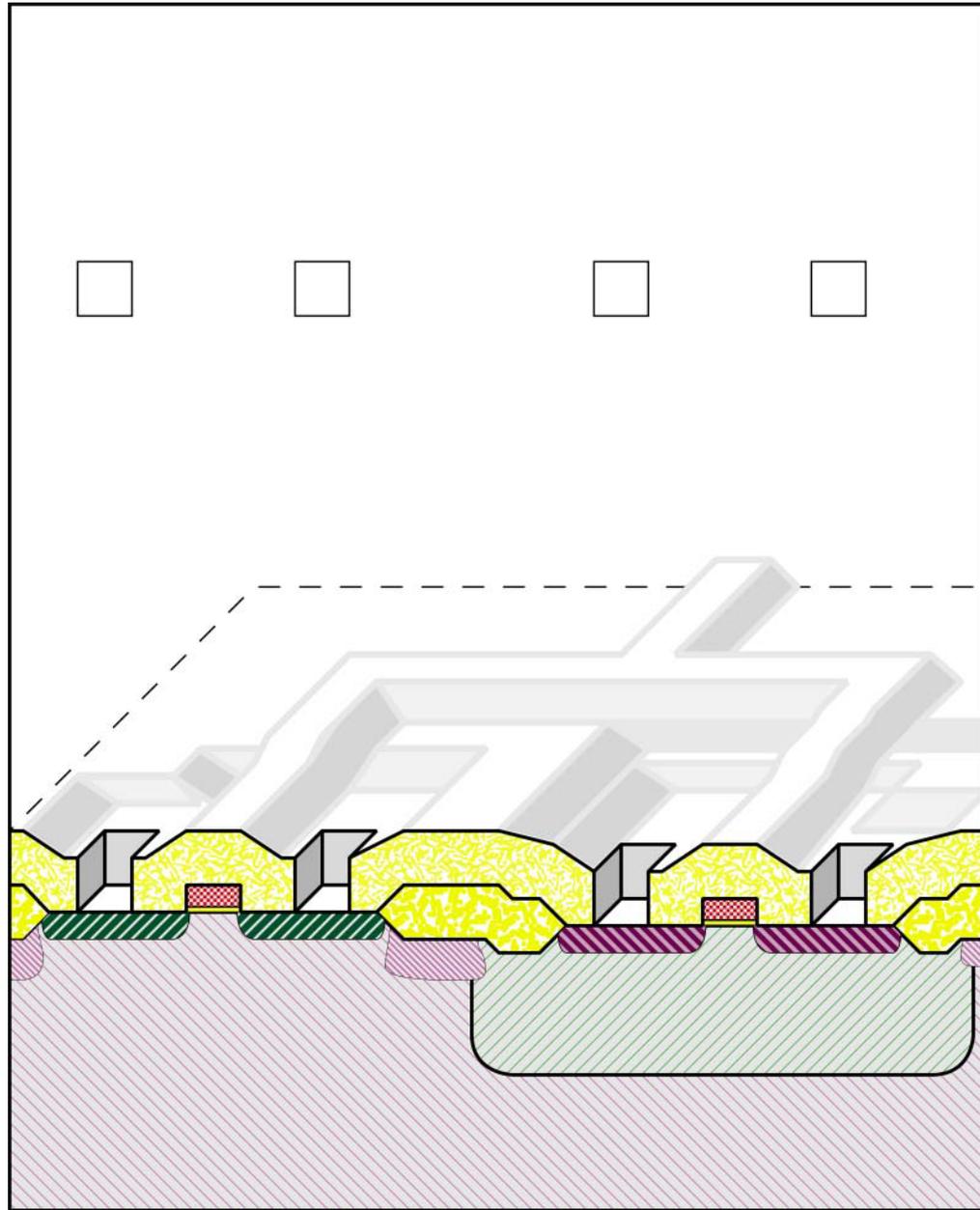
# Transistors



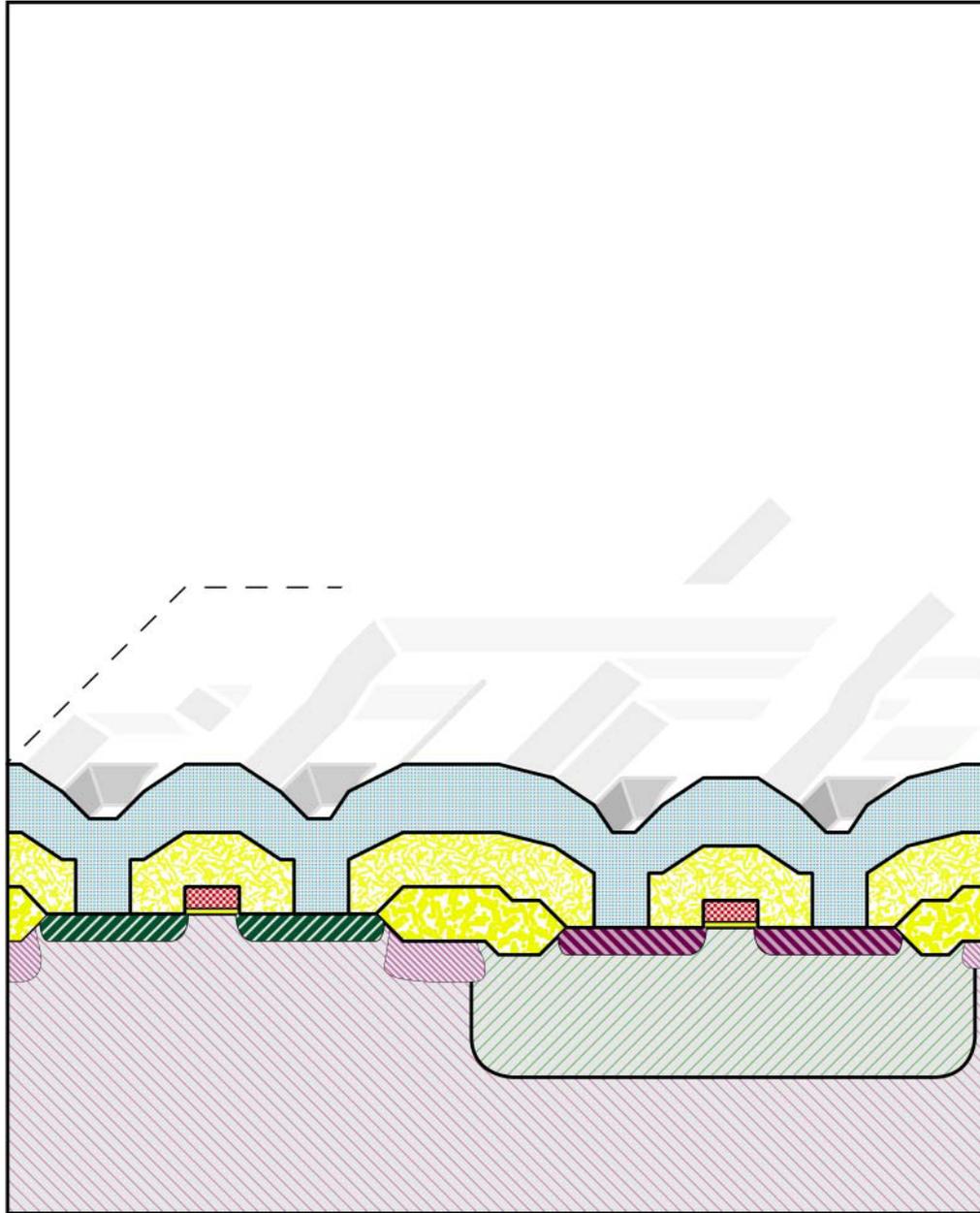
- **Poly litho;**
- **N litho;**
  - Negative pr.
  - N (Phosphorus) implantation.
- **P litho;**
  - Positive pr.
  - P (Boron) implantation.
- **Chemical Vapor Deposited (CVD) oxide;**



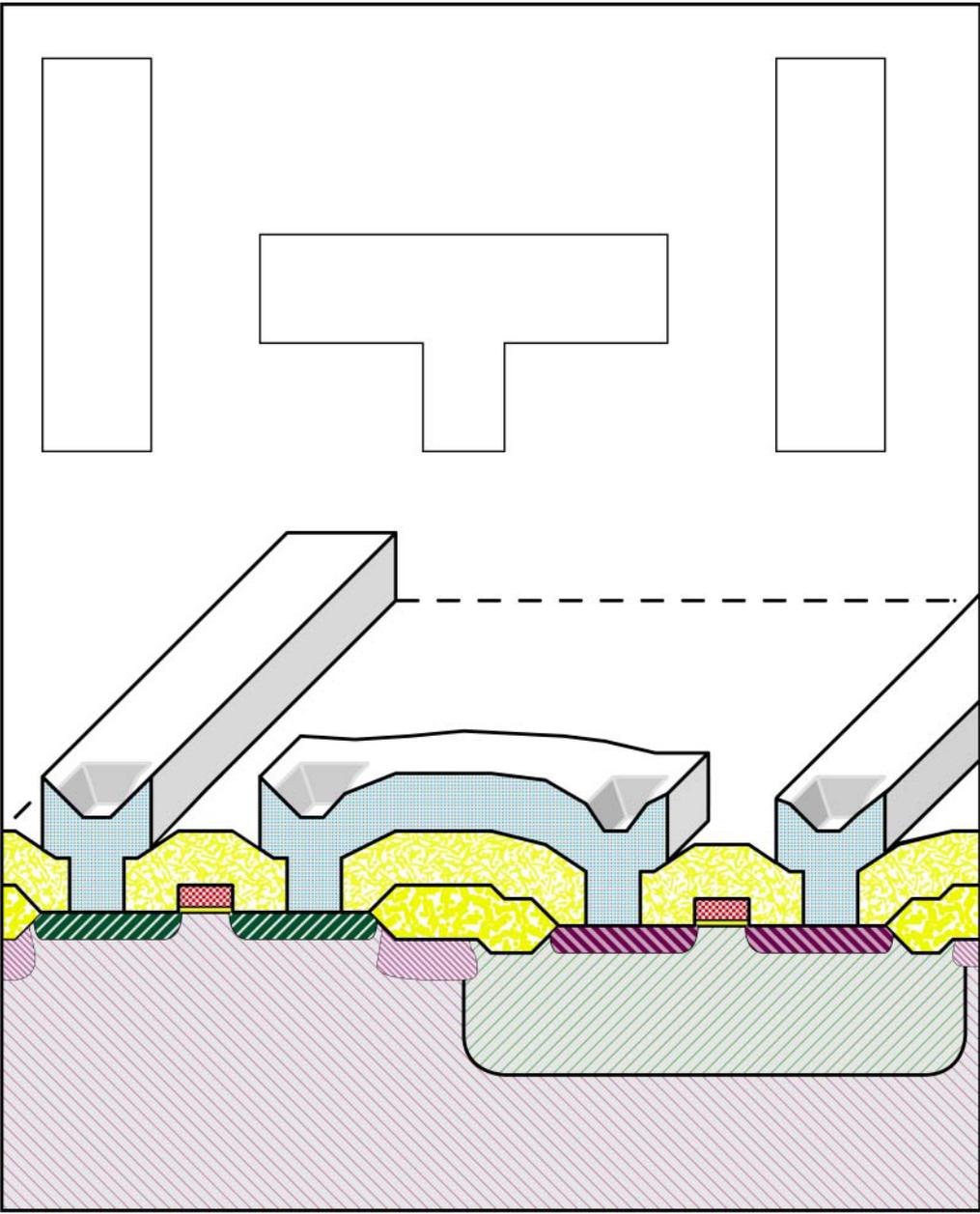
- **CVD oxide;**
- **Contact**
- Litho;**



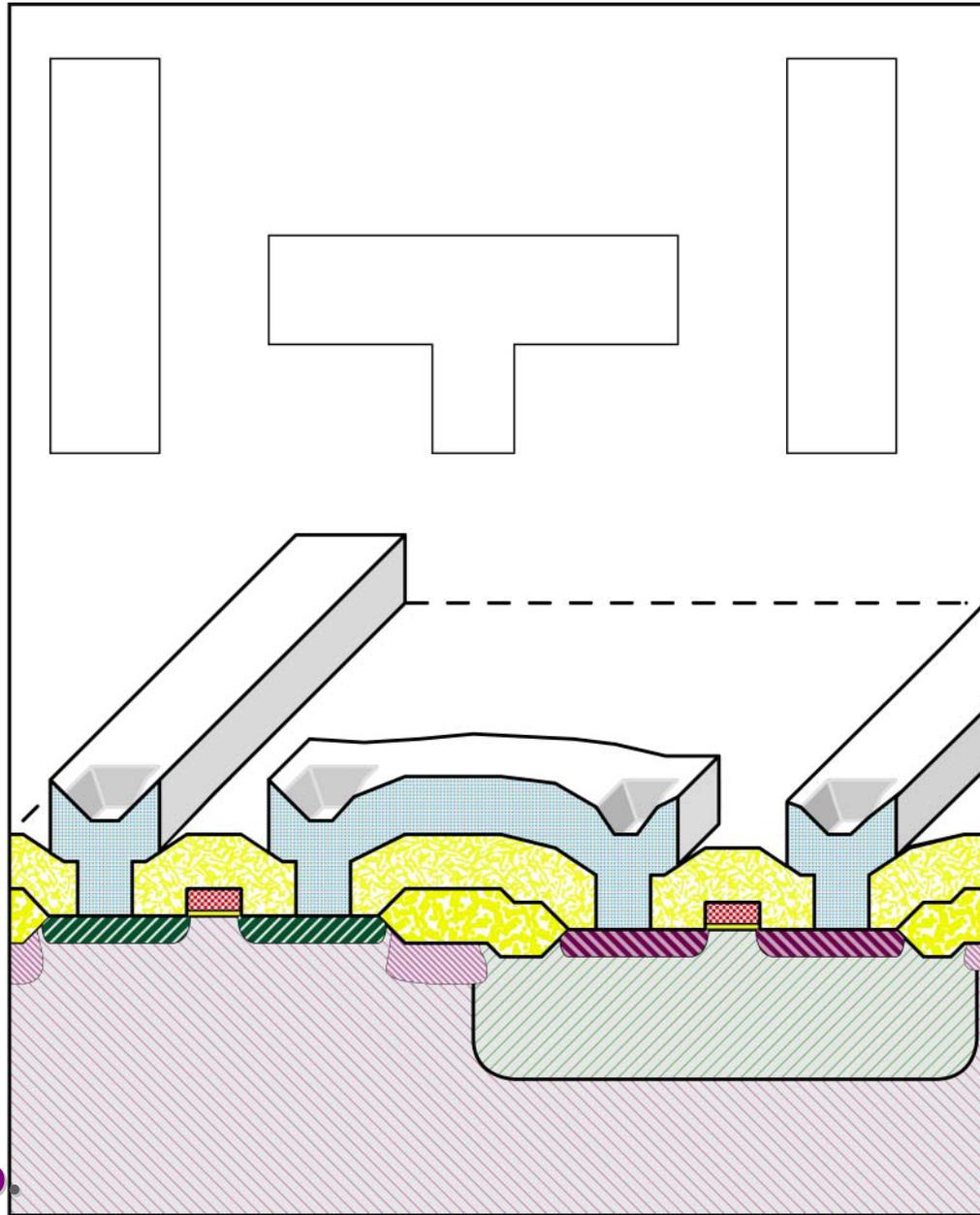
- ➔ **CVD oxide;**
- ➔ **Contact**
- Litho;**
- ➔ **Metal-1**  
**deposition;**



- ➔ **CVD oxide;**
- ➔ **Contact**
- Litho;**
- ➔ **Metal-1**
- deposition;**
- ➔ **Metal-1**
- Litho.**



- ☞ **CVD oxide;**
- ☞ **Contact Litho;**
- ☞ **Metal-1  
deposition;**
- ☞ **Metal-1 Litho.**
- ☞ **CVD oxide;**
- ☞ **Via-1 Litho;**
- ☞ **Metal-2  
deposition;**
- ☞ **Metal-2 Litho.**
- ☞ **Over-glass  
deposition/litho.**



# Inverter

