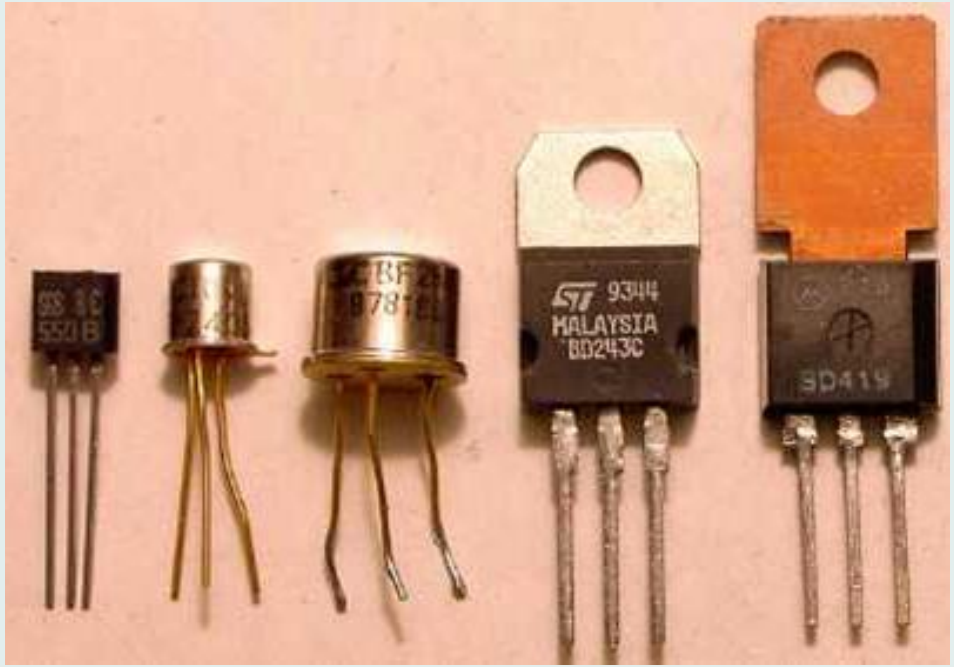
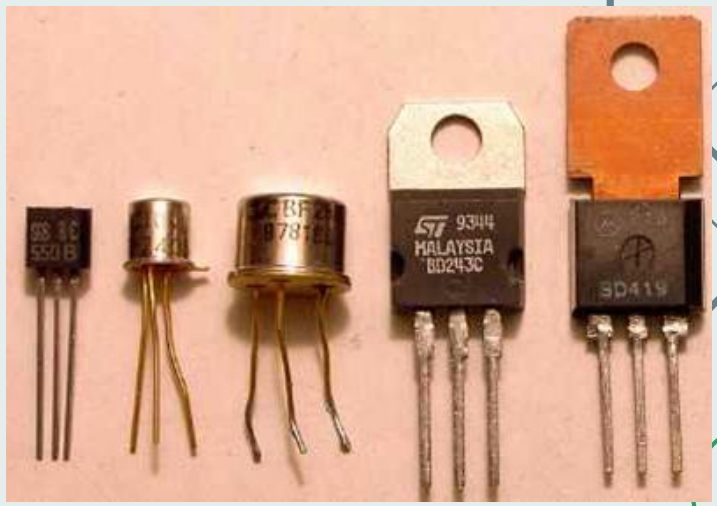
沙子到黃金
——一個電晶體的誕生

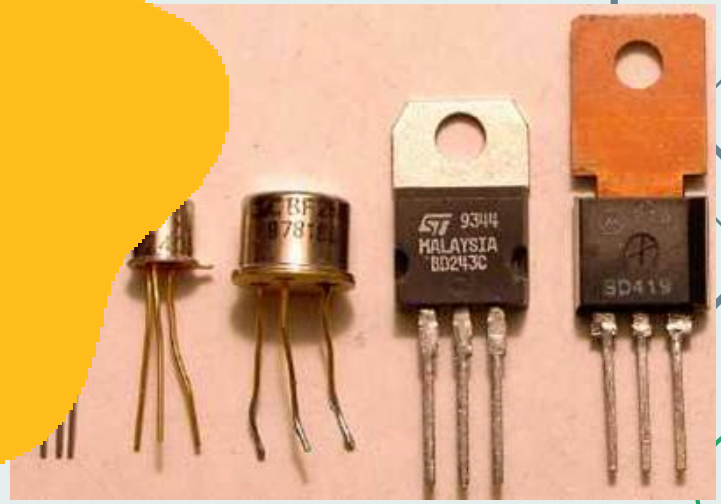
鍊金術師：翁宥縈、郭芯妤、張丞希

你看過沙子嗎？

你看過電晶體嗎？

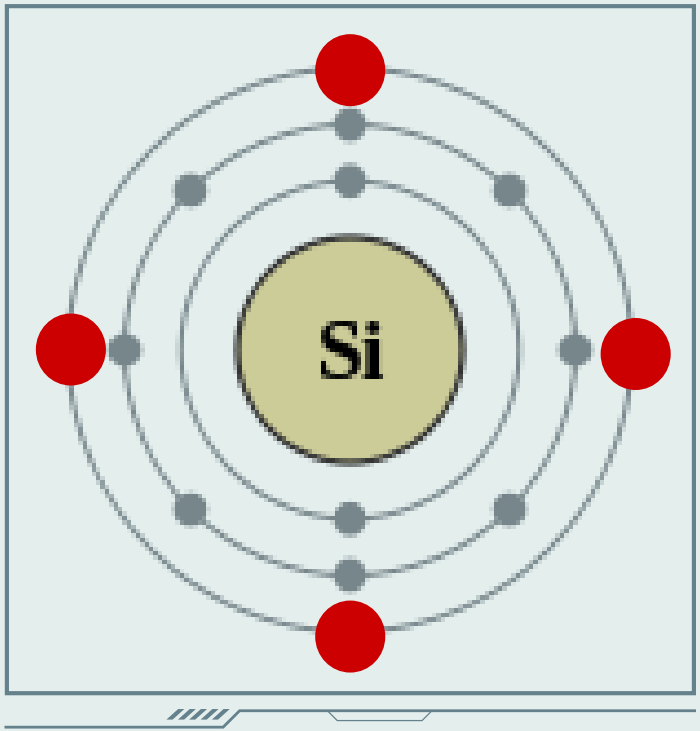



9344
MALAYSIA
BD243C
BD419


9344
MALAYSIA
BD243C
BD419

半導體
（semiconductor）

常見的半導體材料:矽(Si)、鍺(Ge)、…



每個矽原子有4個價電子

在常温情況下，各原子之間會形成共價鍵

一、矽的純化

將矽土放入高温爐進行反應

目的:去除矽土雜質，讓他們變乾淨

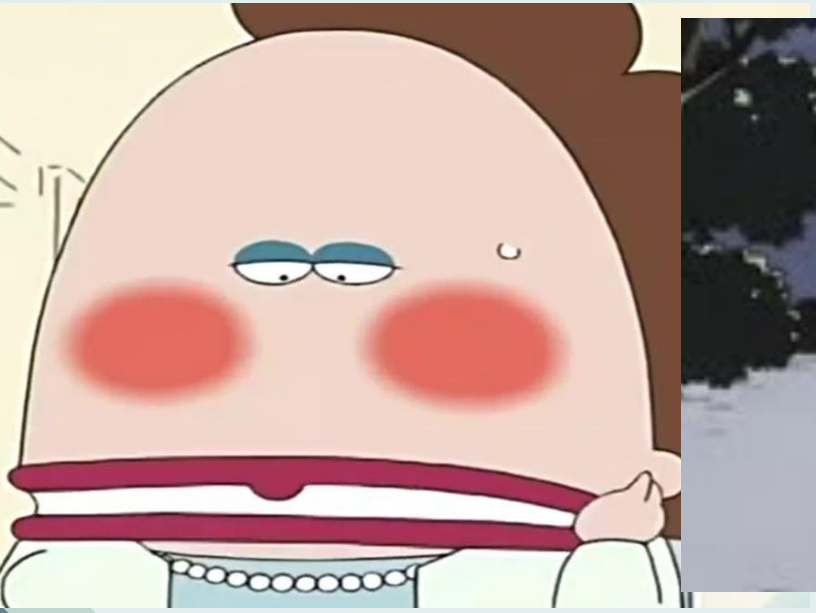
最終產物:高純度多晶矽(乾淨的沙)

二、矽晶柱長晶

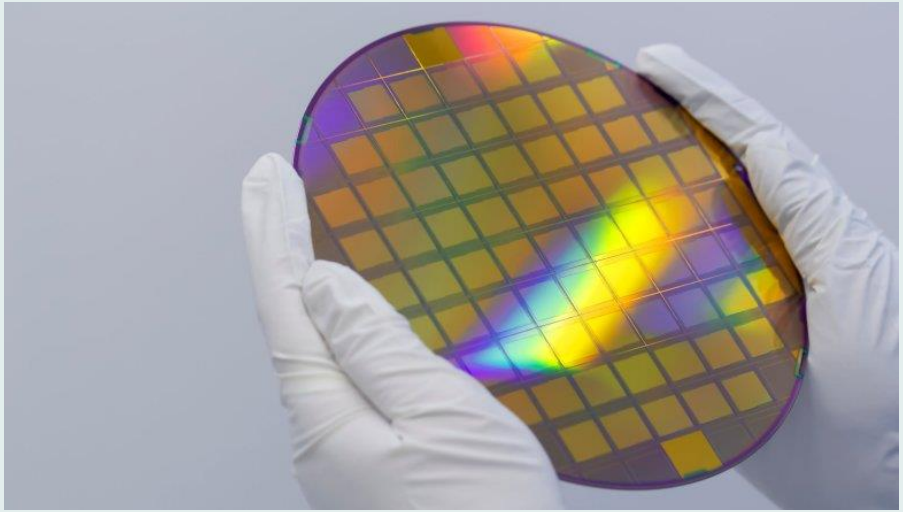
目的:使矽原子整齊排列

過程:將高純度的多晶矽(乾淨的矽)放入高温爐中長晶

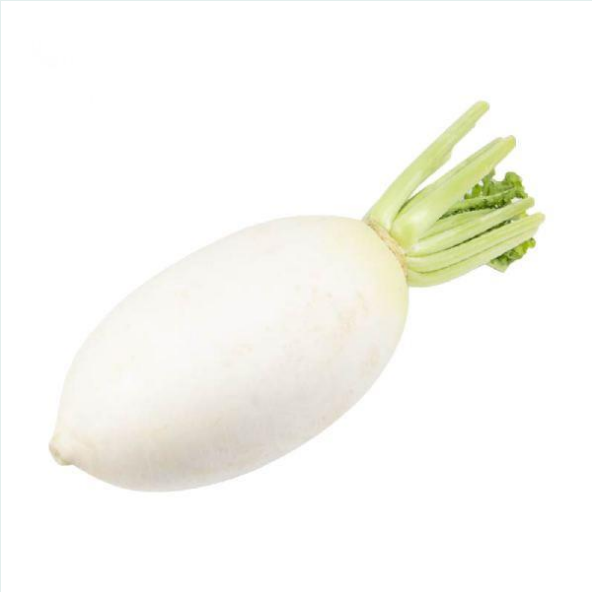
最終產物:高純度單晶矽晶柱(減重又長高)



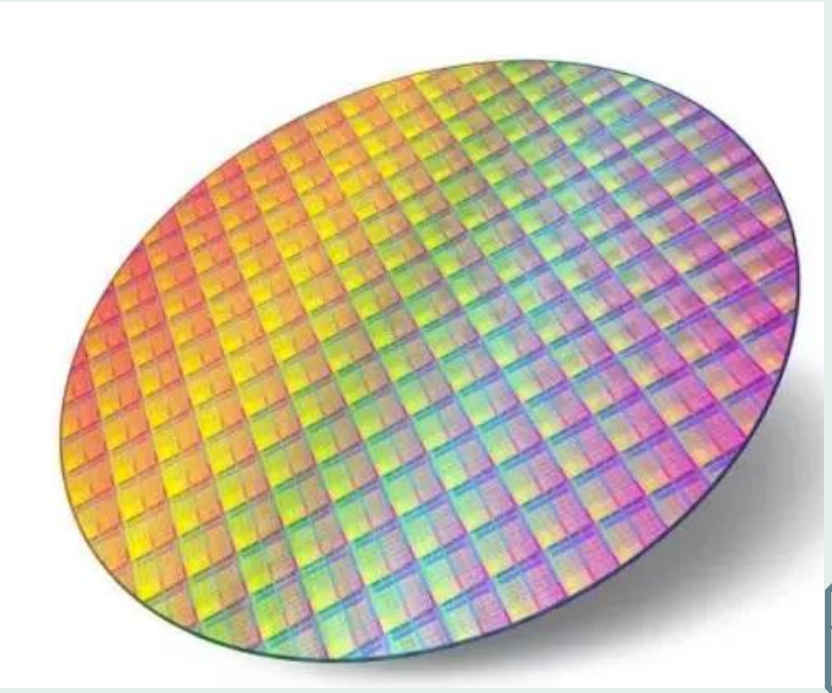
三、矽晶柱->晶圓



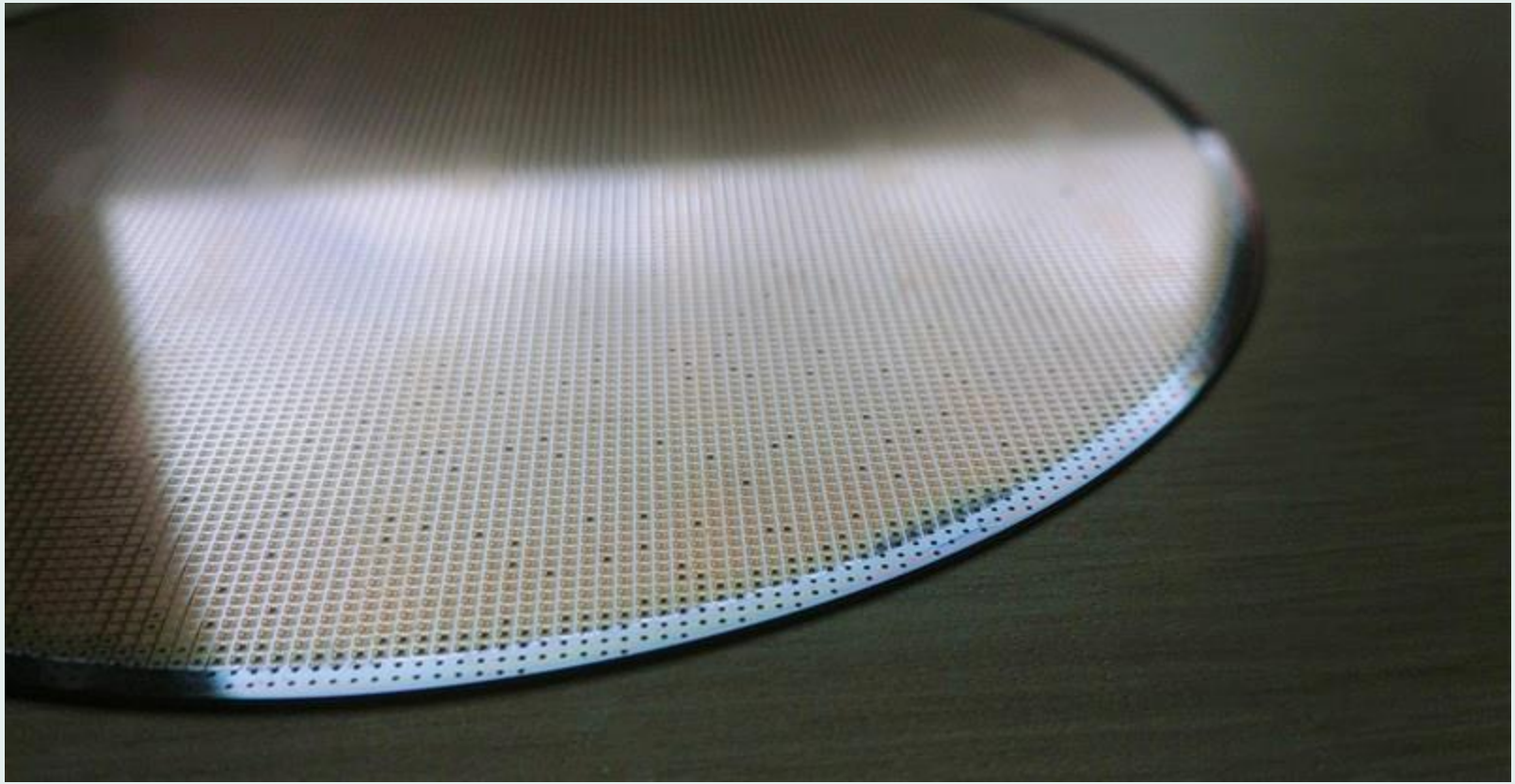
三、矽晶柱->晶圓



晶圓完成了！



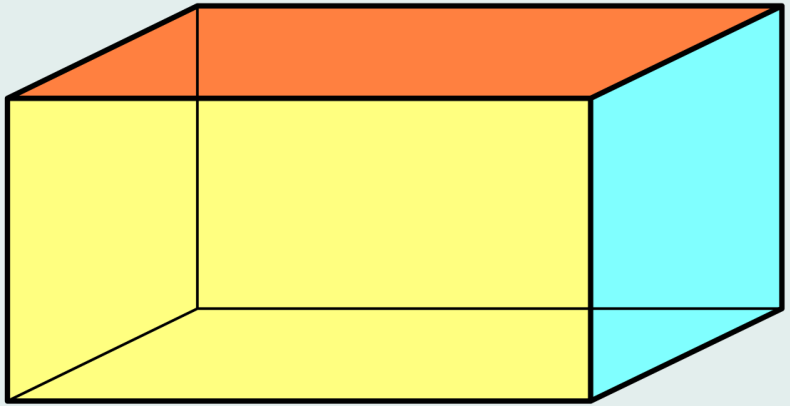
晶圓做好了，下一步是什麼？



電晶體

分層

分層



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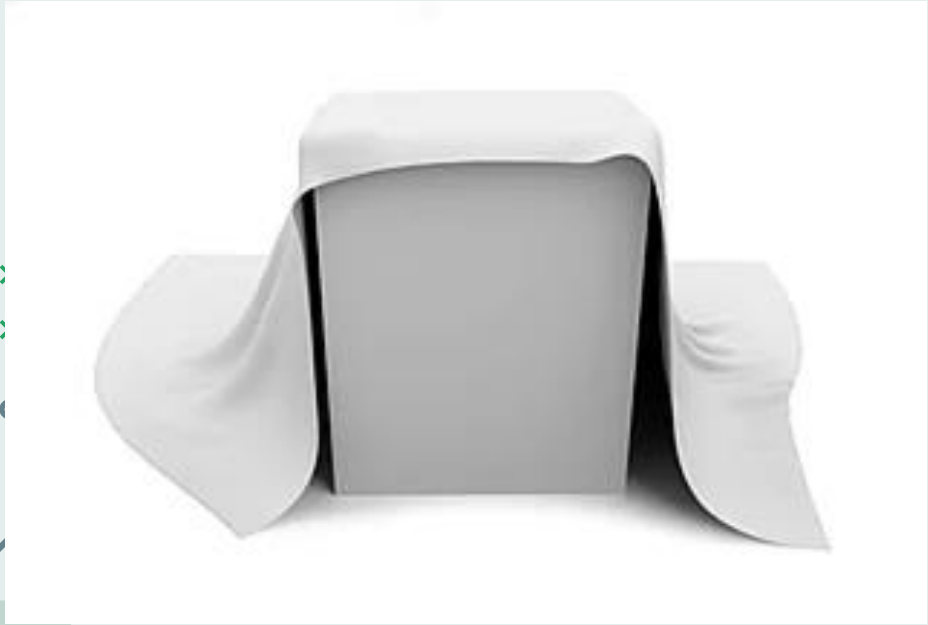
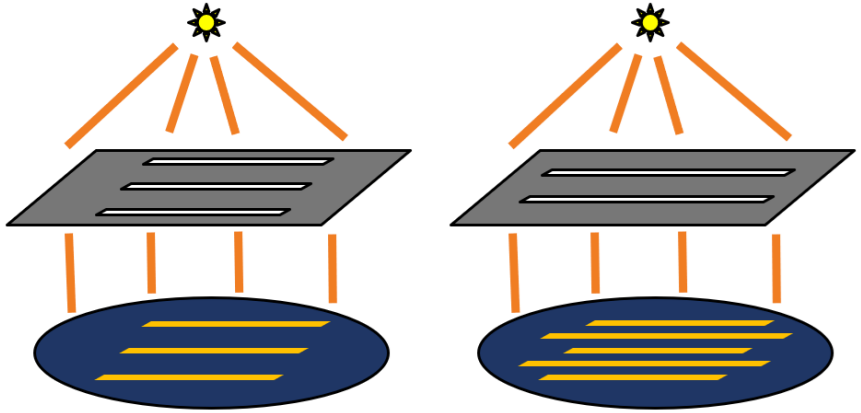
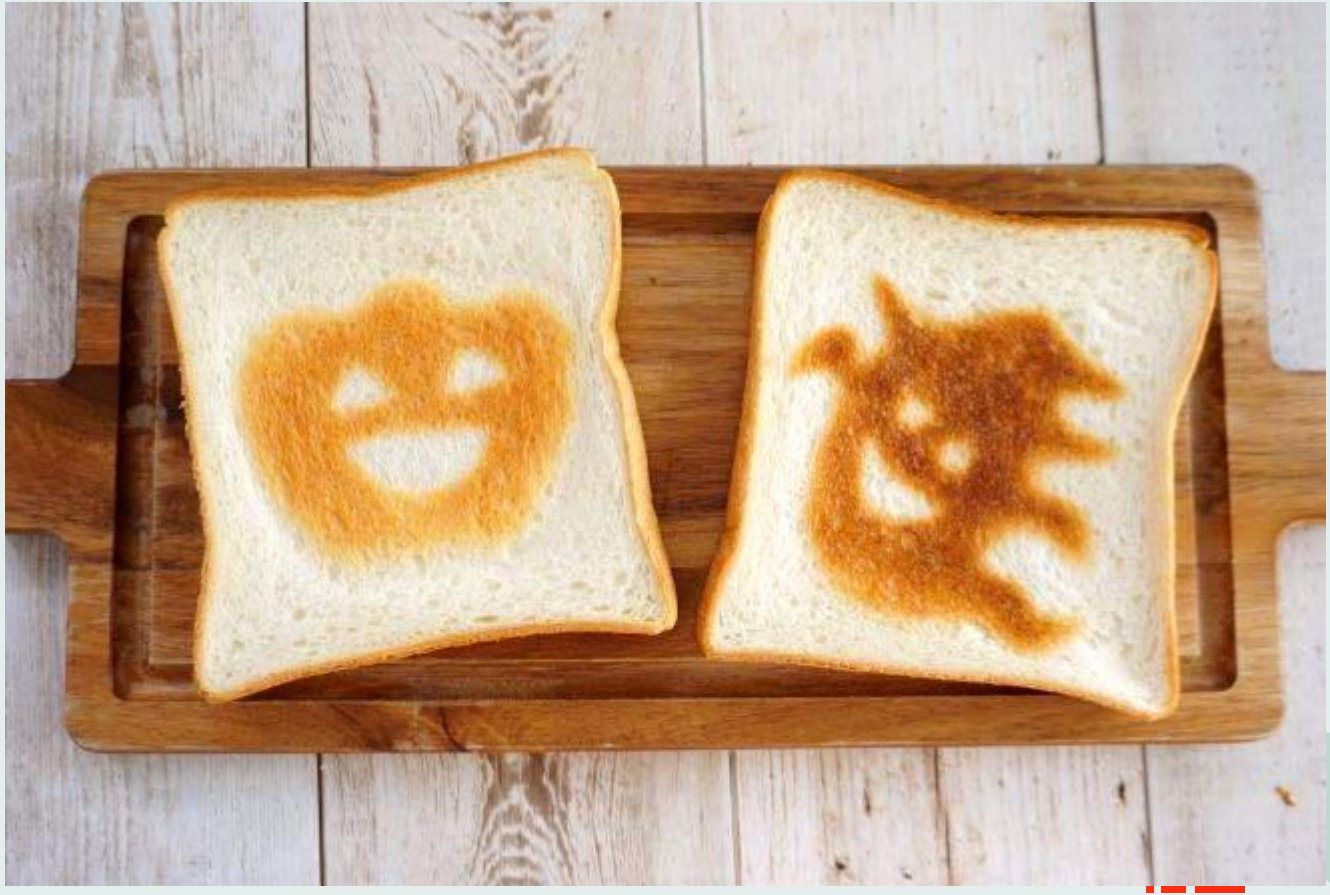


微影

光罩

光照



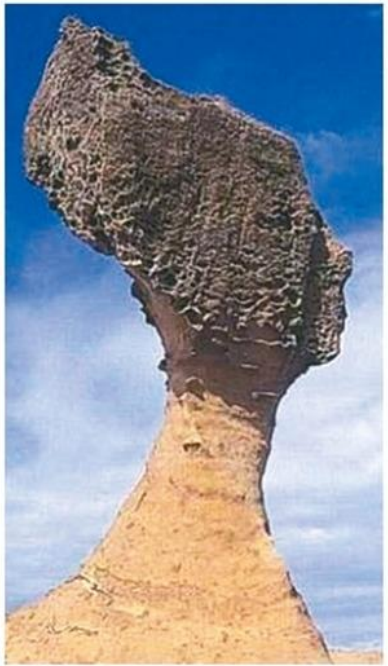


蝕刻

女王頭風化過程

1969 年

1980 年



1990 年

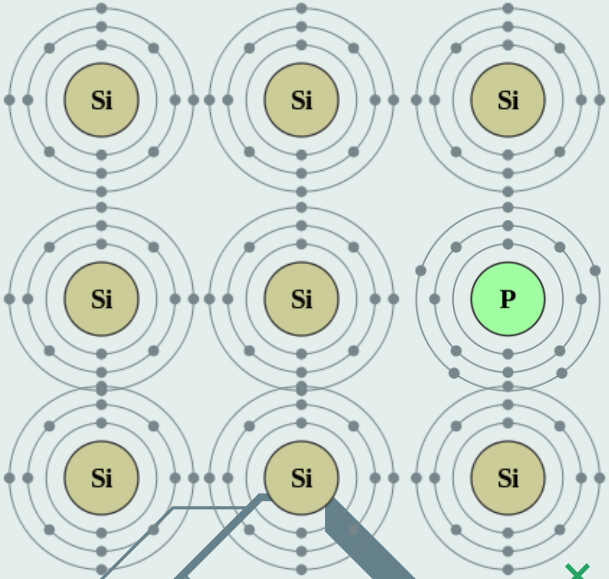
2010 年

ㄔㄢ摻雜

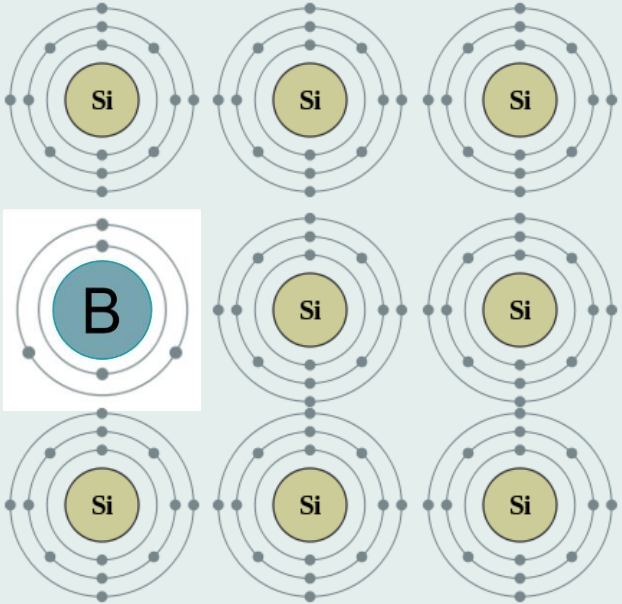
摻雜

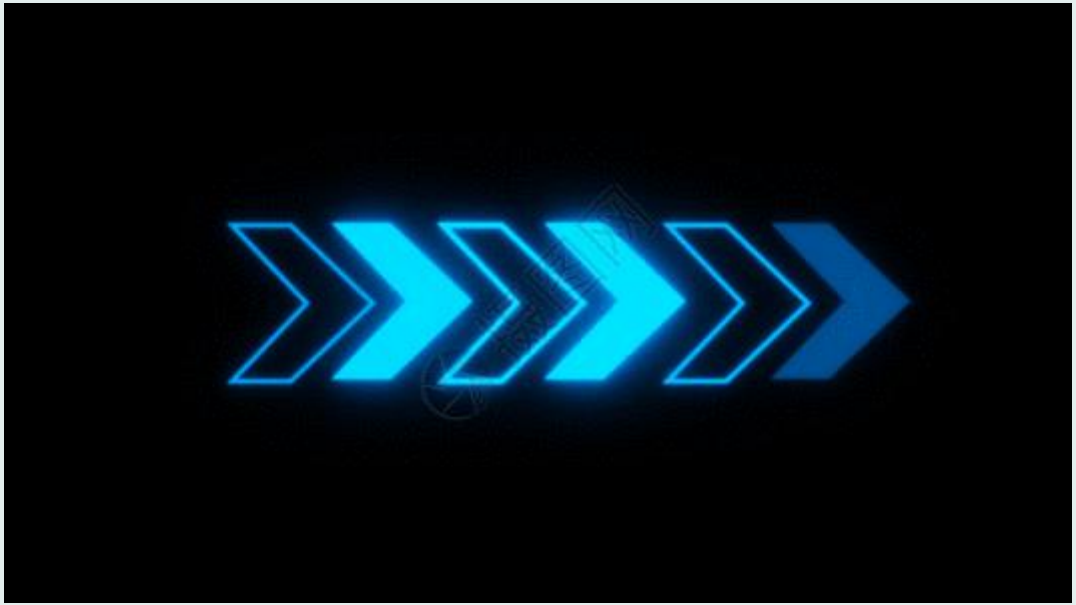
為了讓矽原子有導電和不導電的兩種特性，需在其中摻雜少量元素

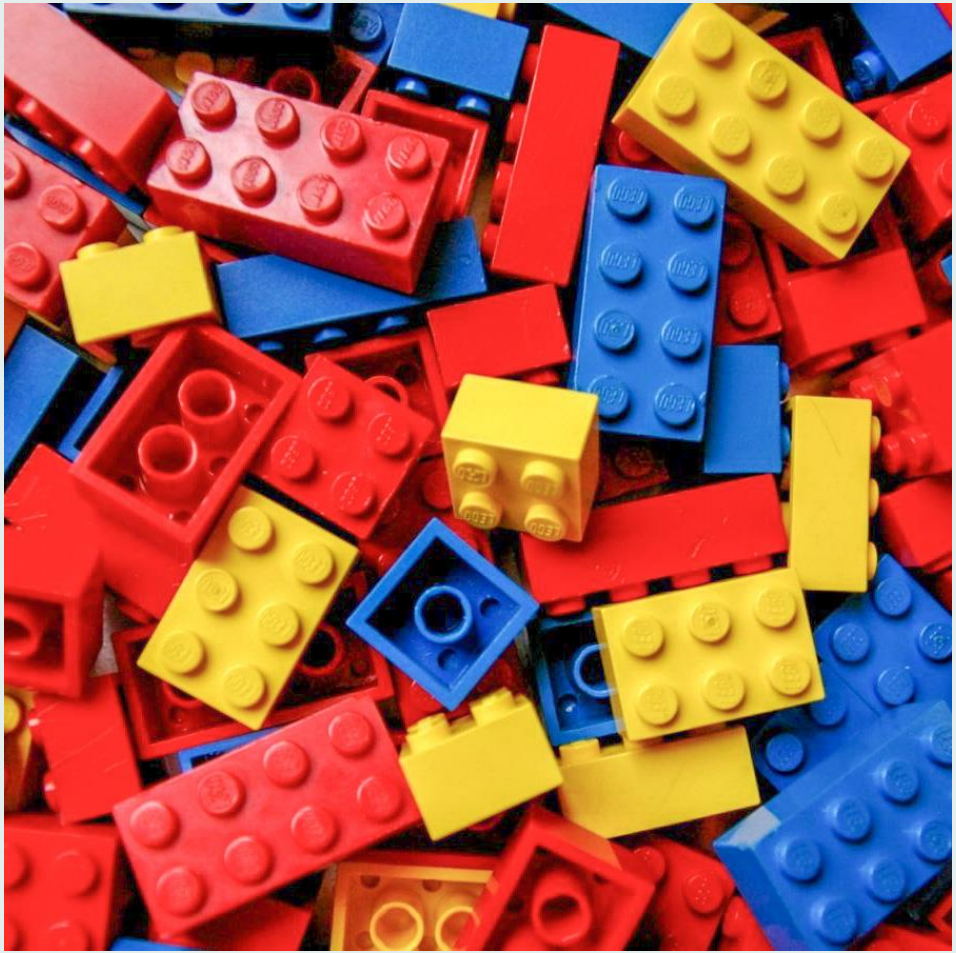
電子(加入5A族)



電洞(加入3A族)





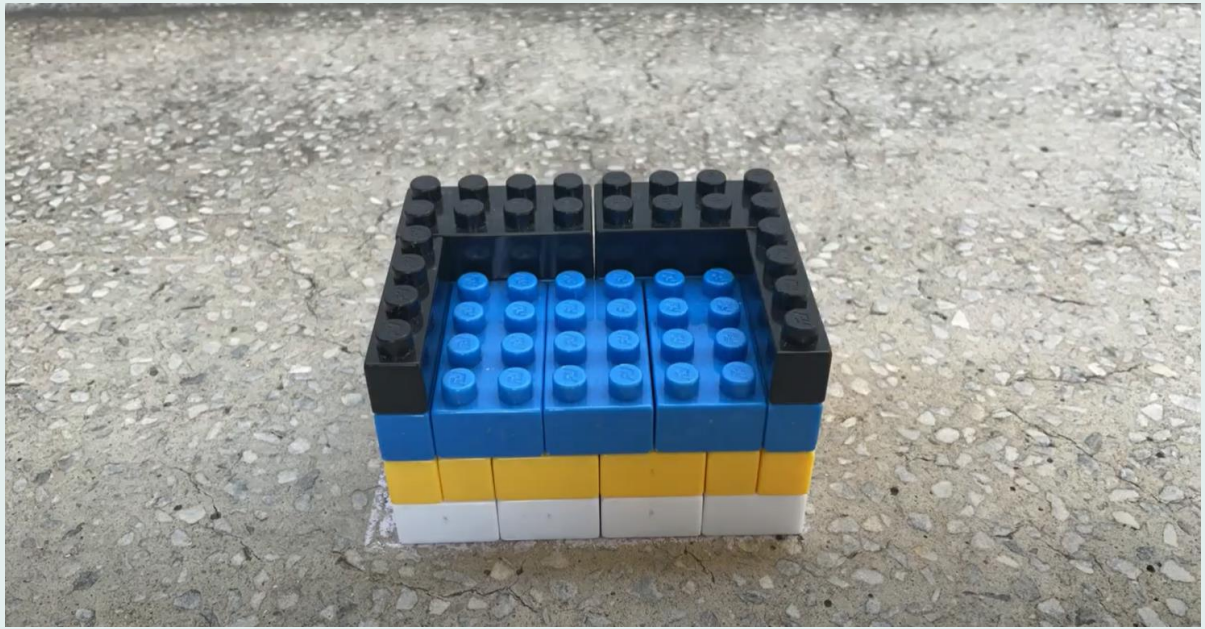


先拚好塔基底(非實際長晶過程)

表面氧化

塗抹光阻

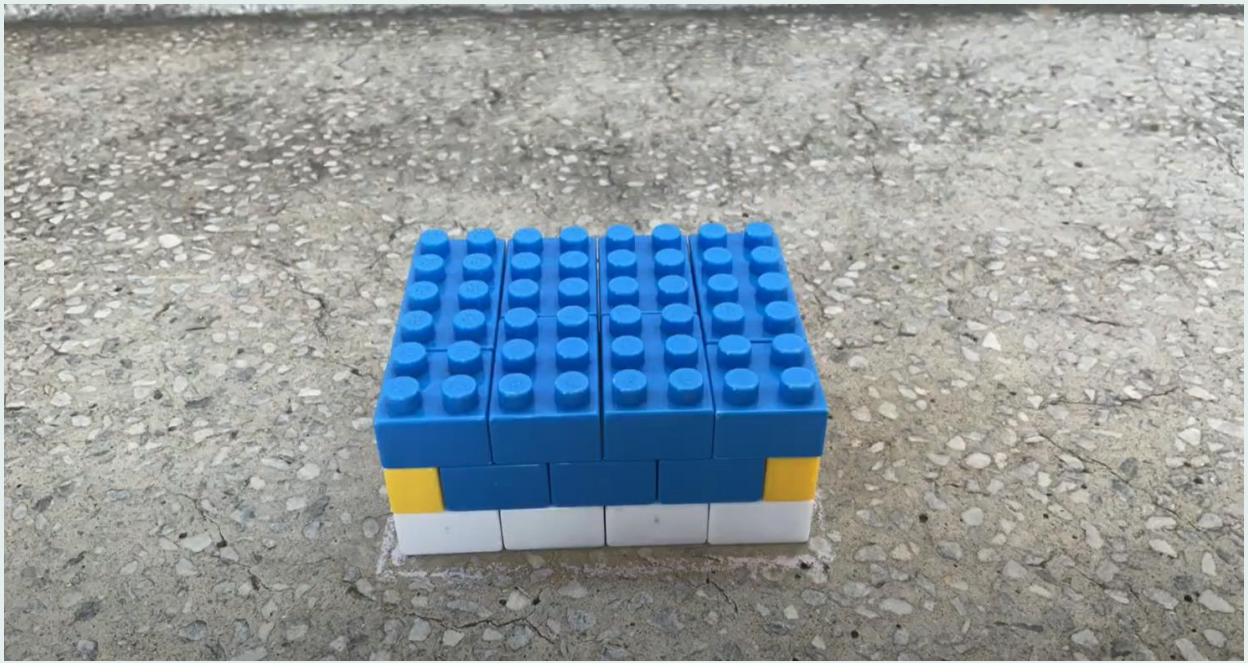
放光罩&曝光



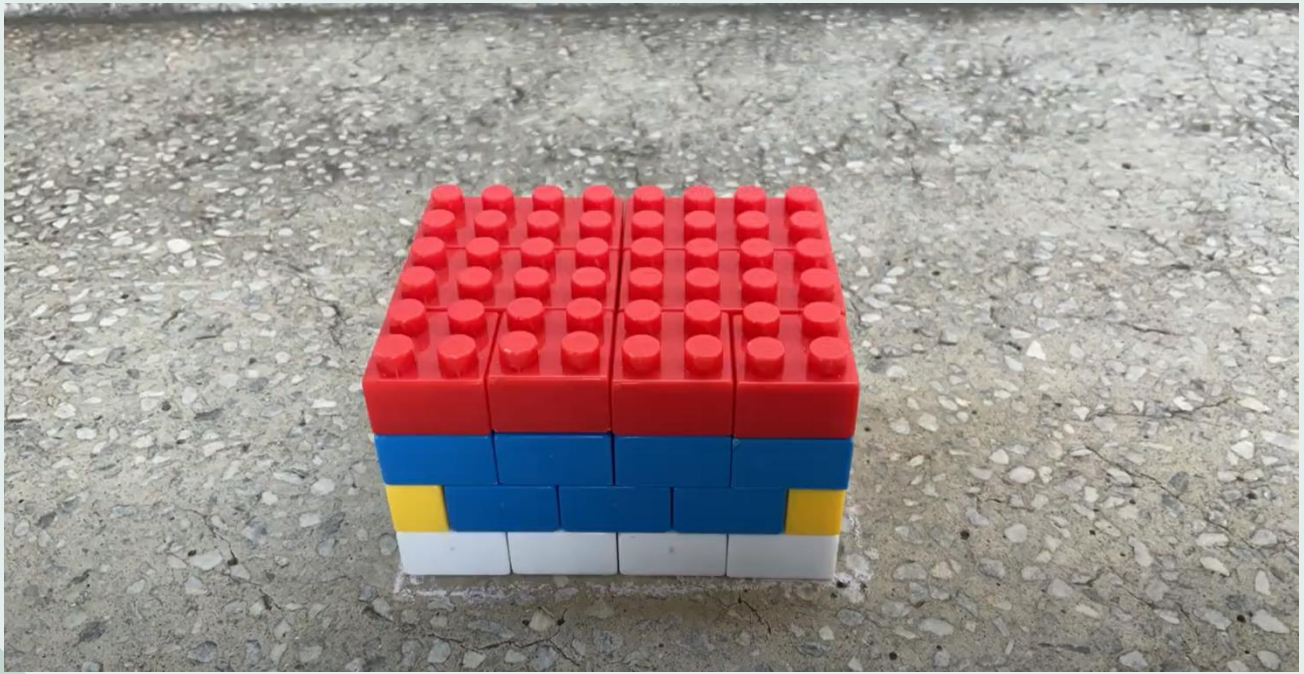
顯影

蝕刻&去除剩餘光阻

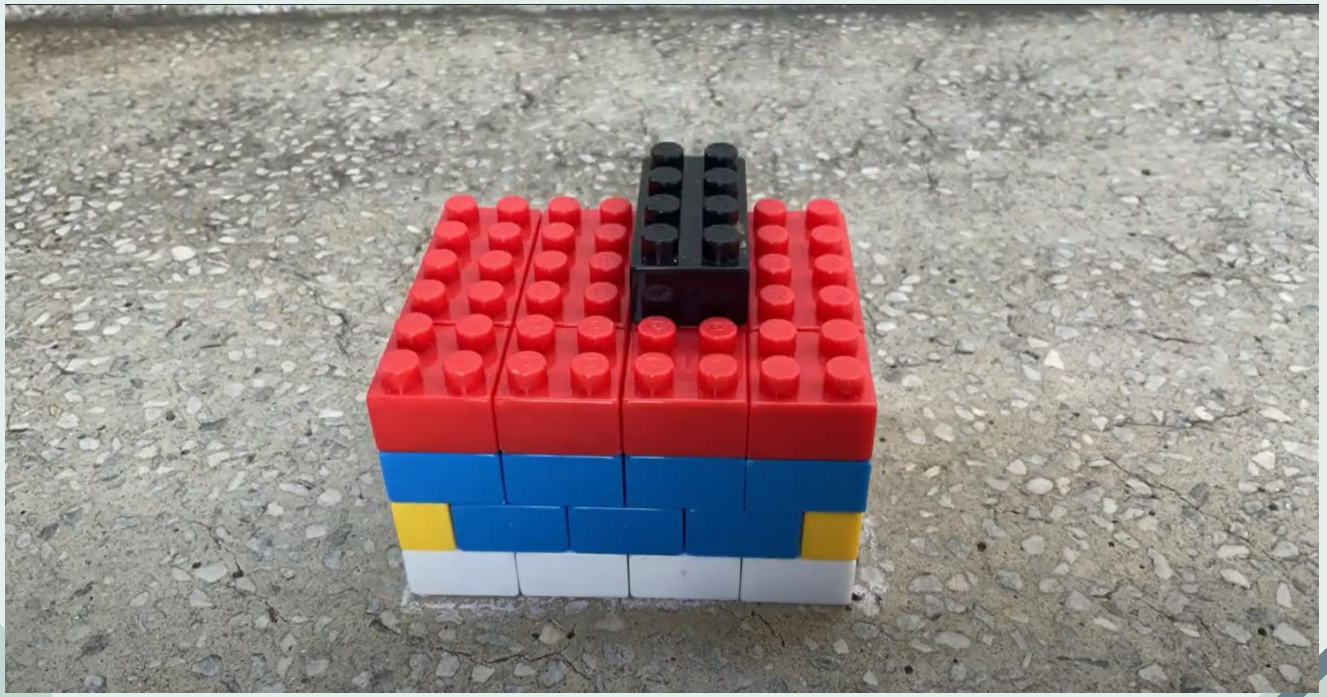
多晶矽沉積



塗抹光阻



放光罩&曝光



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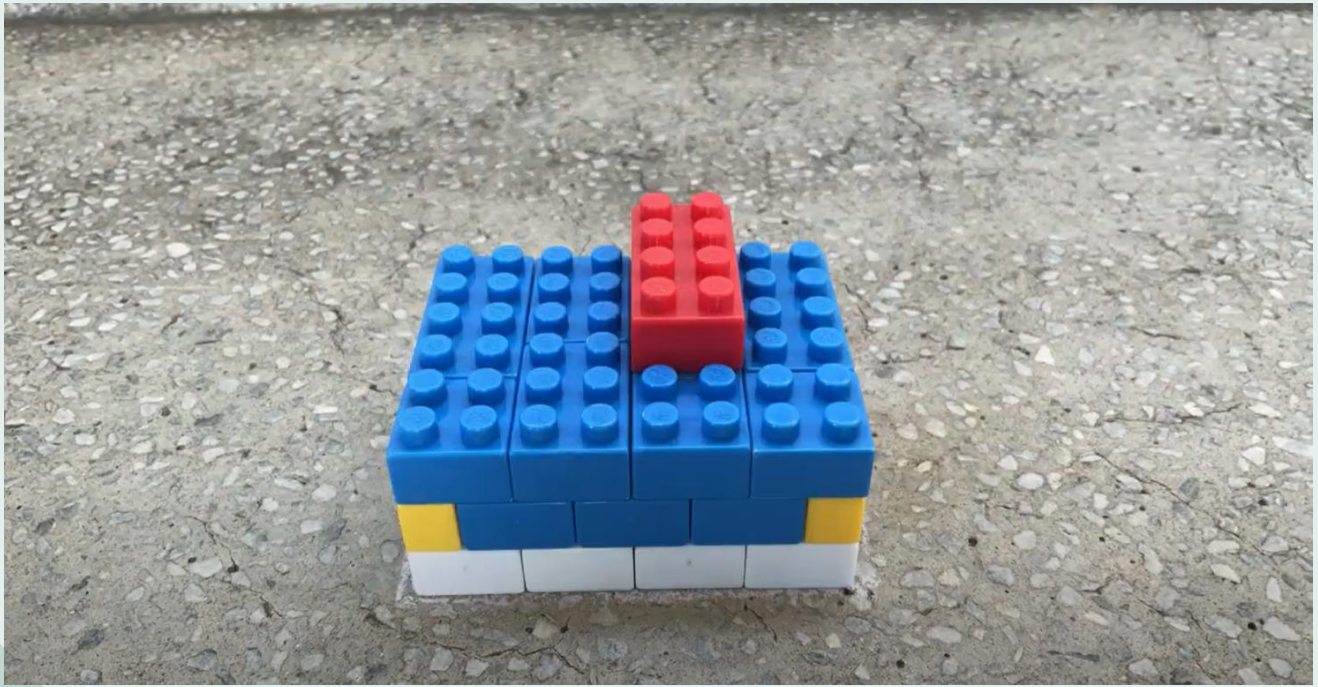

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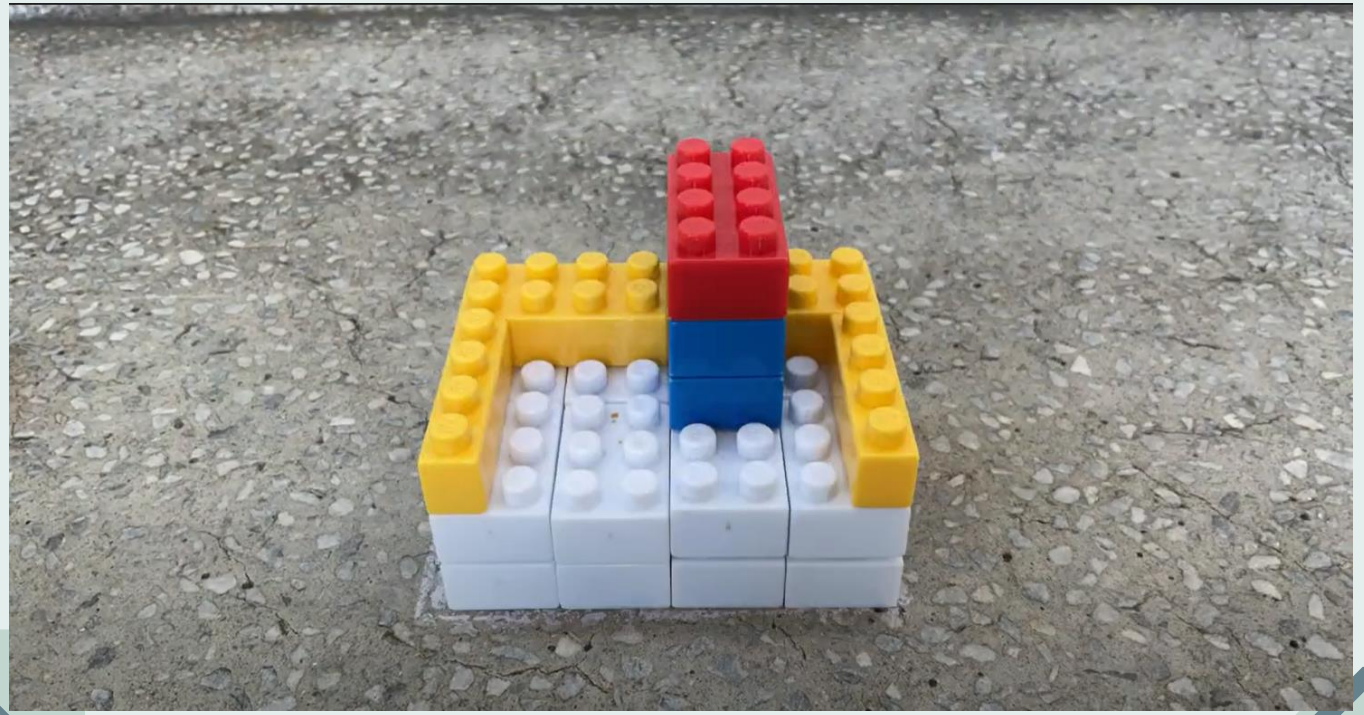
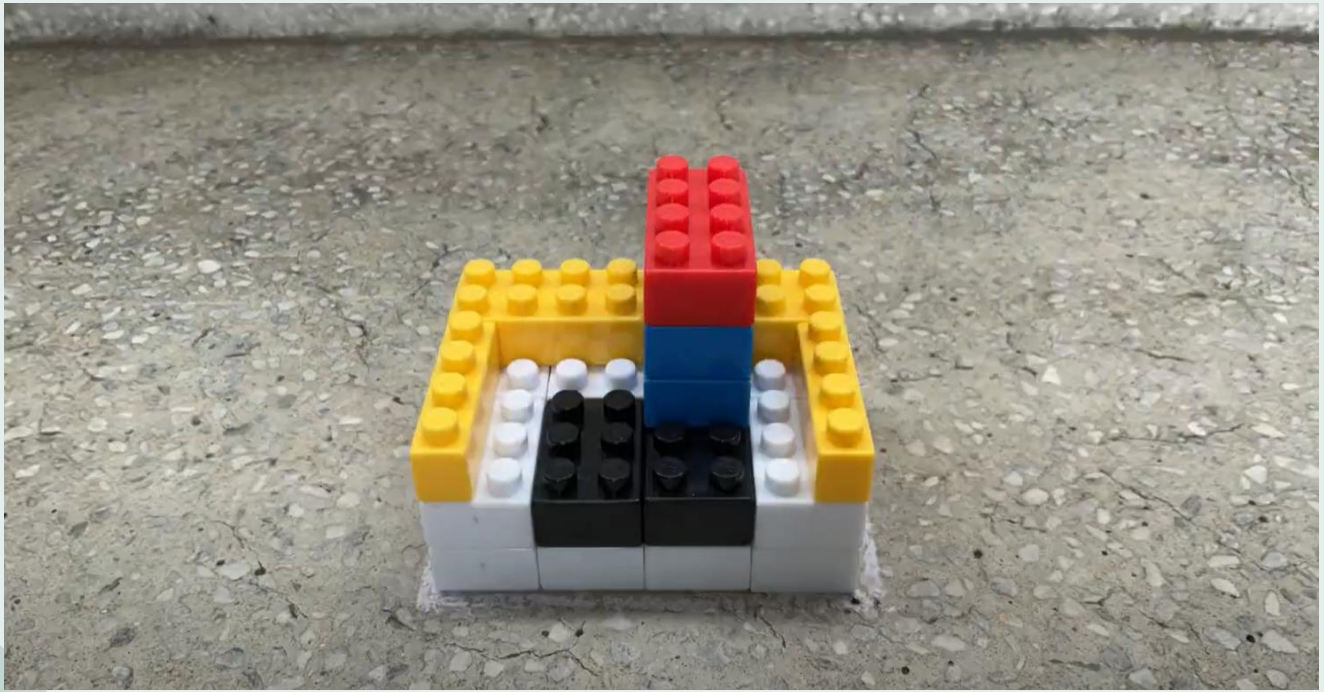
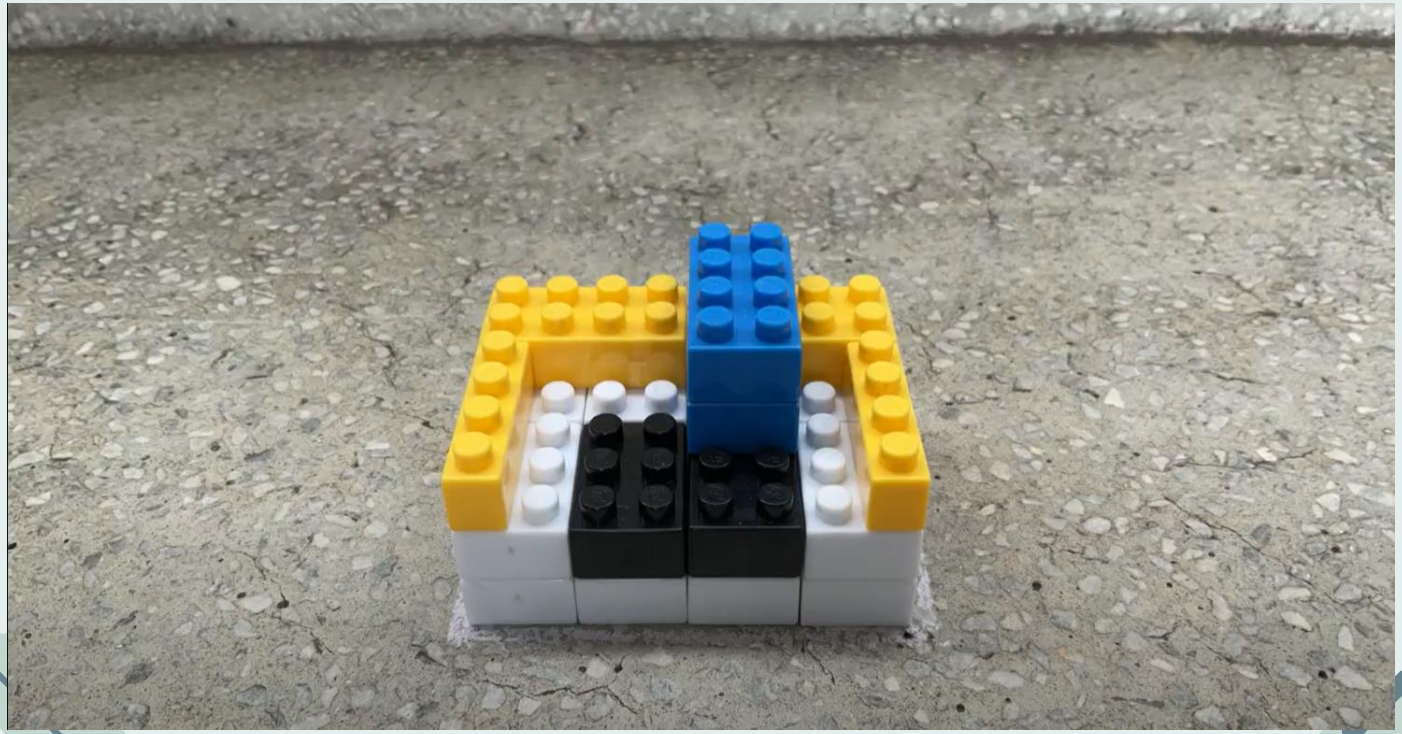


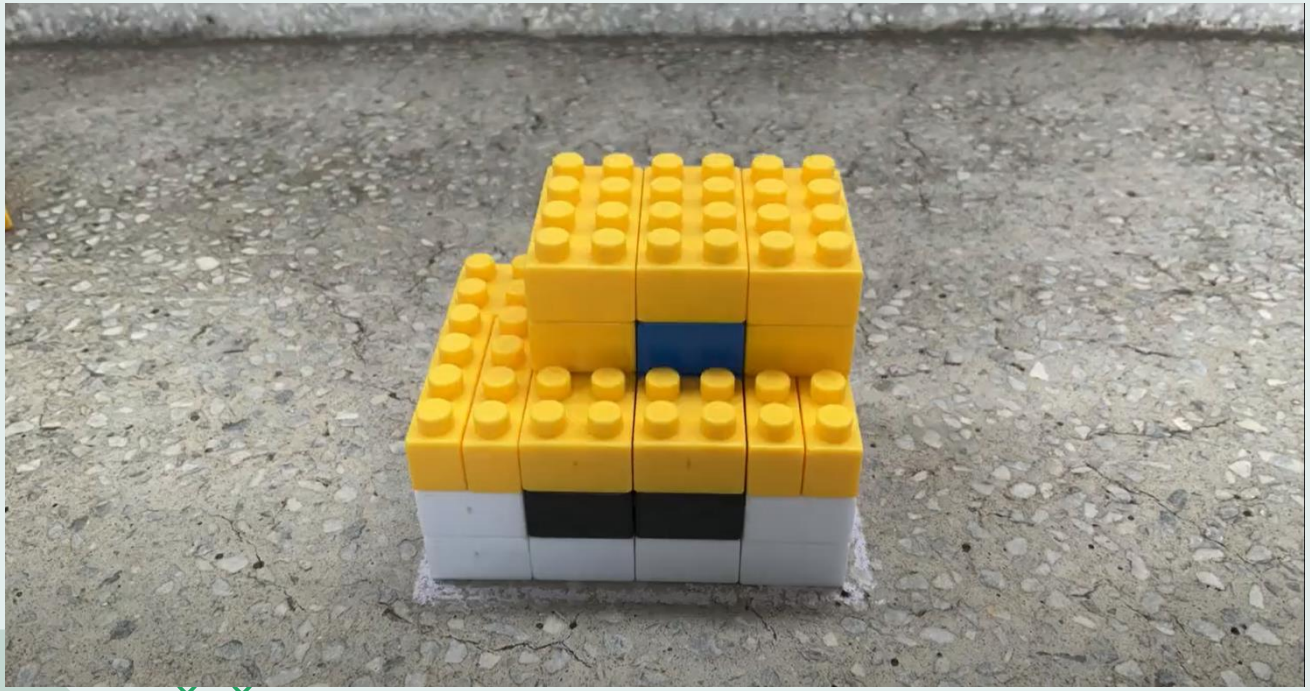
摻雜



去除剩餘光阻



表面氧化



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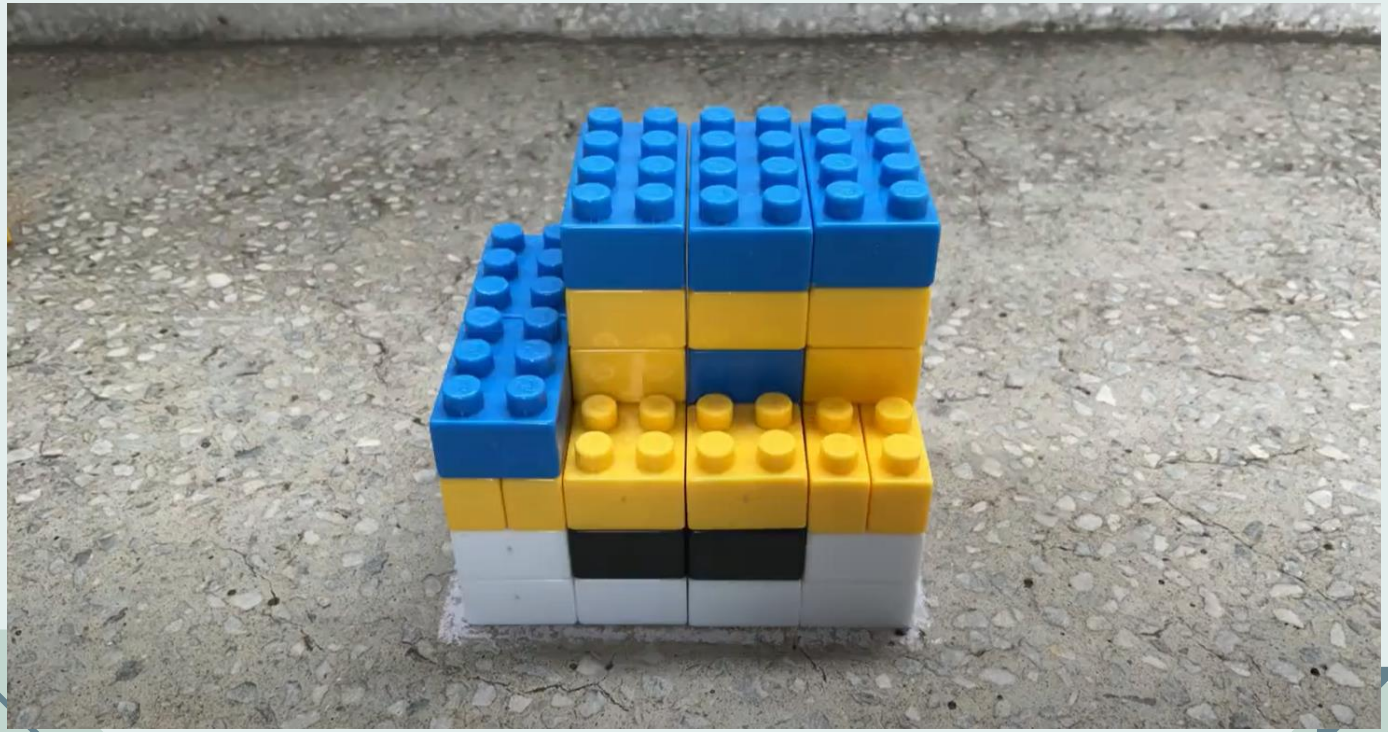
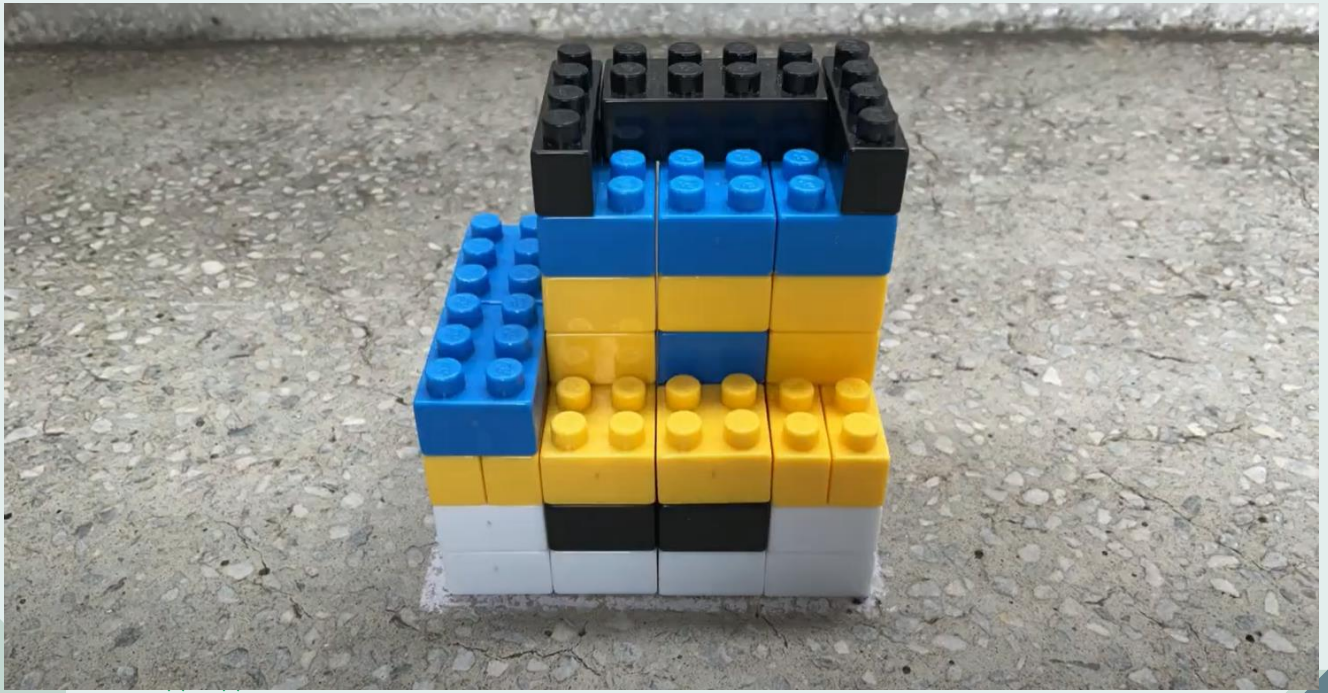


放光罩&曝光



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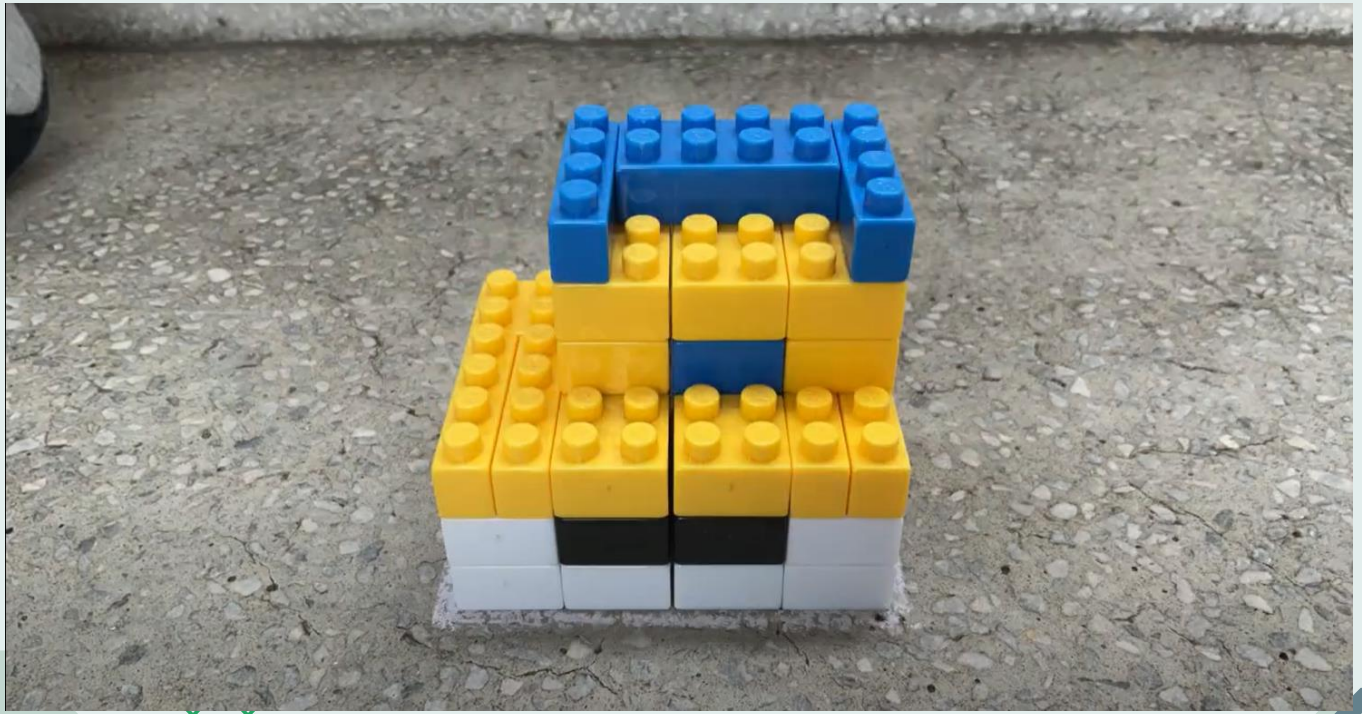

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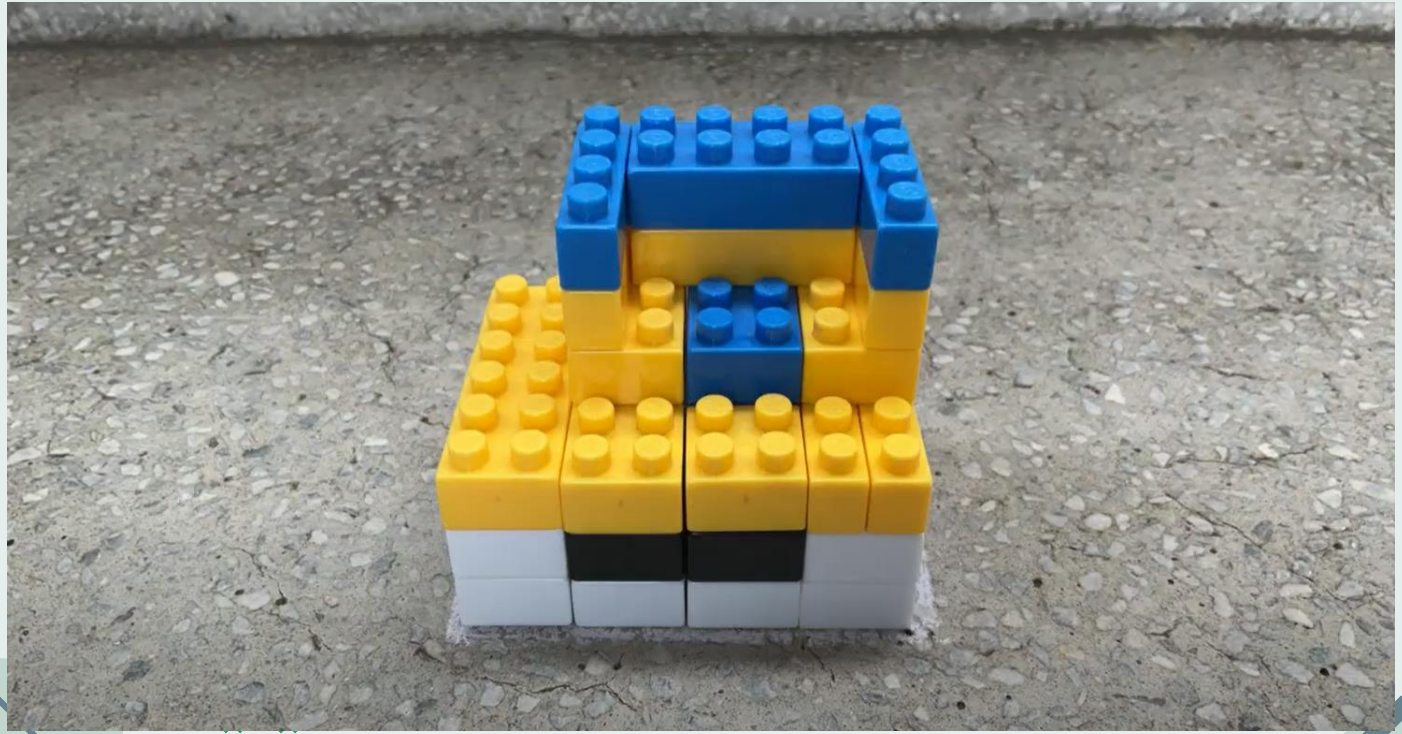

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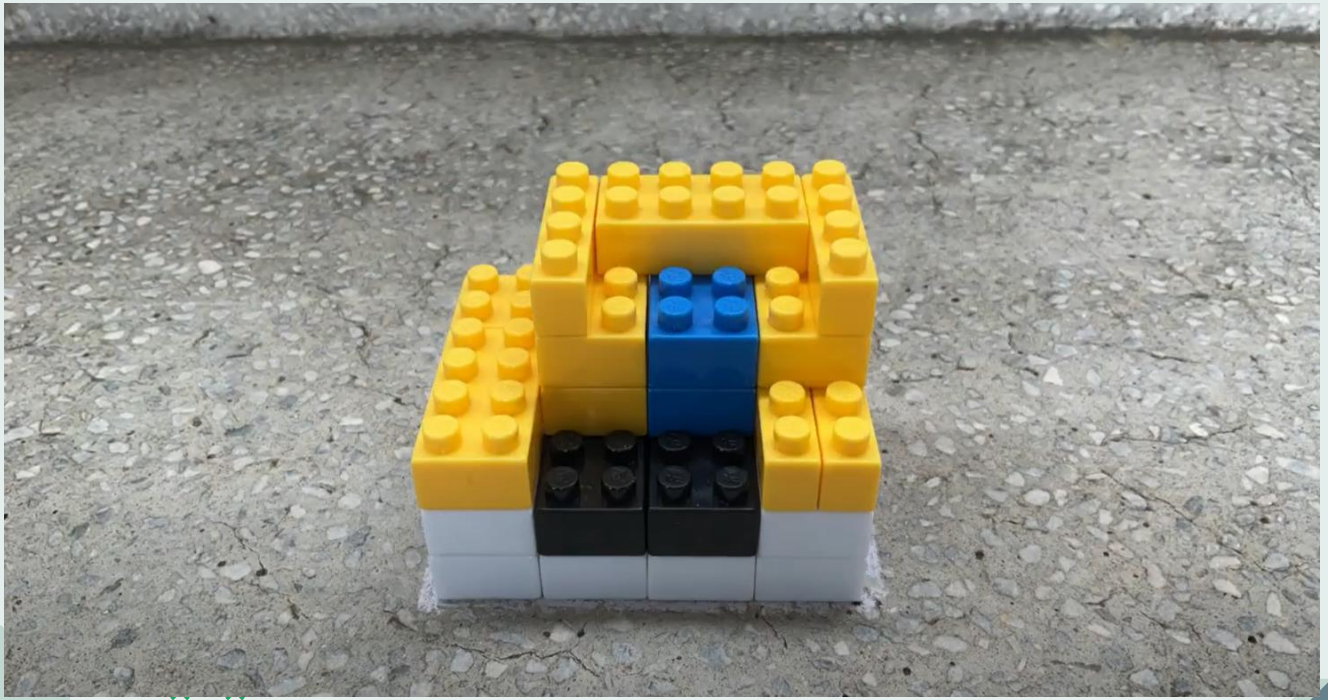
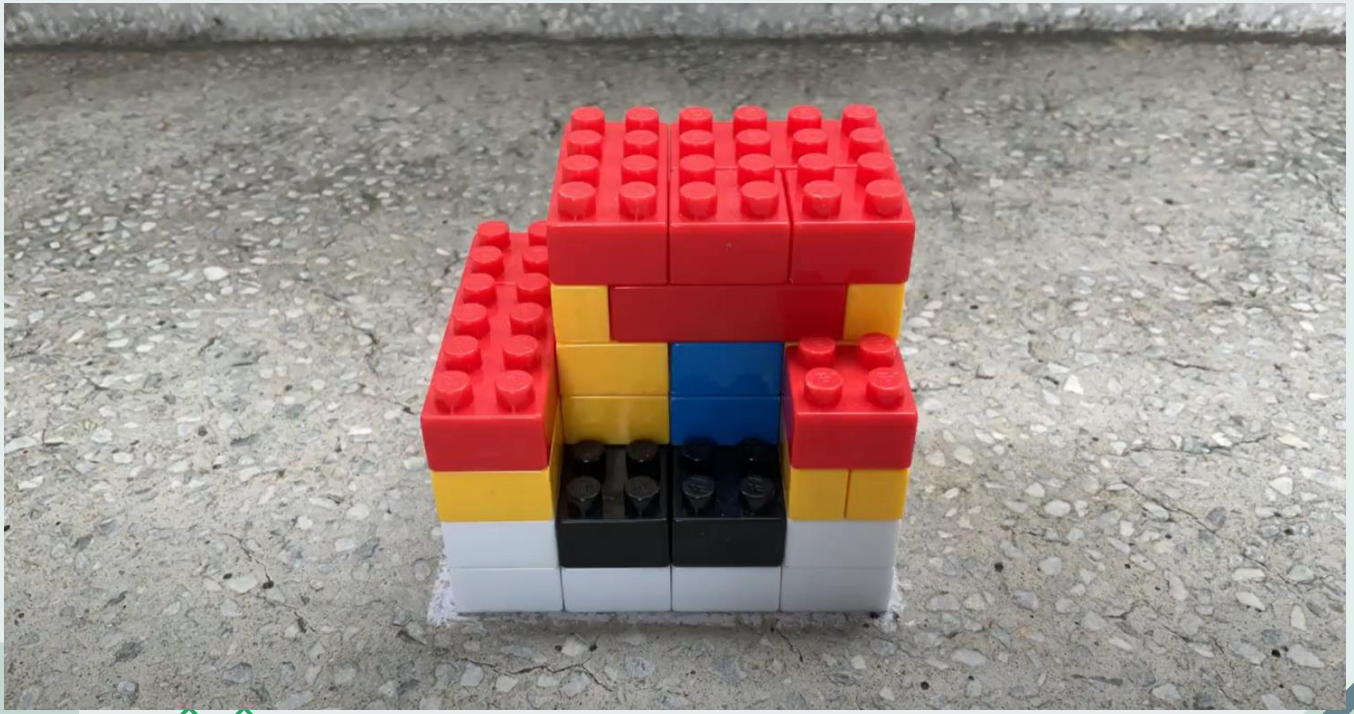


金屬薄膜沉積



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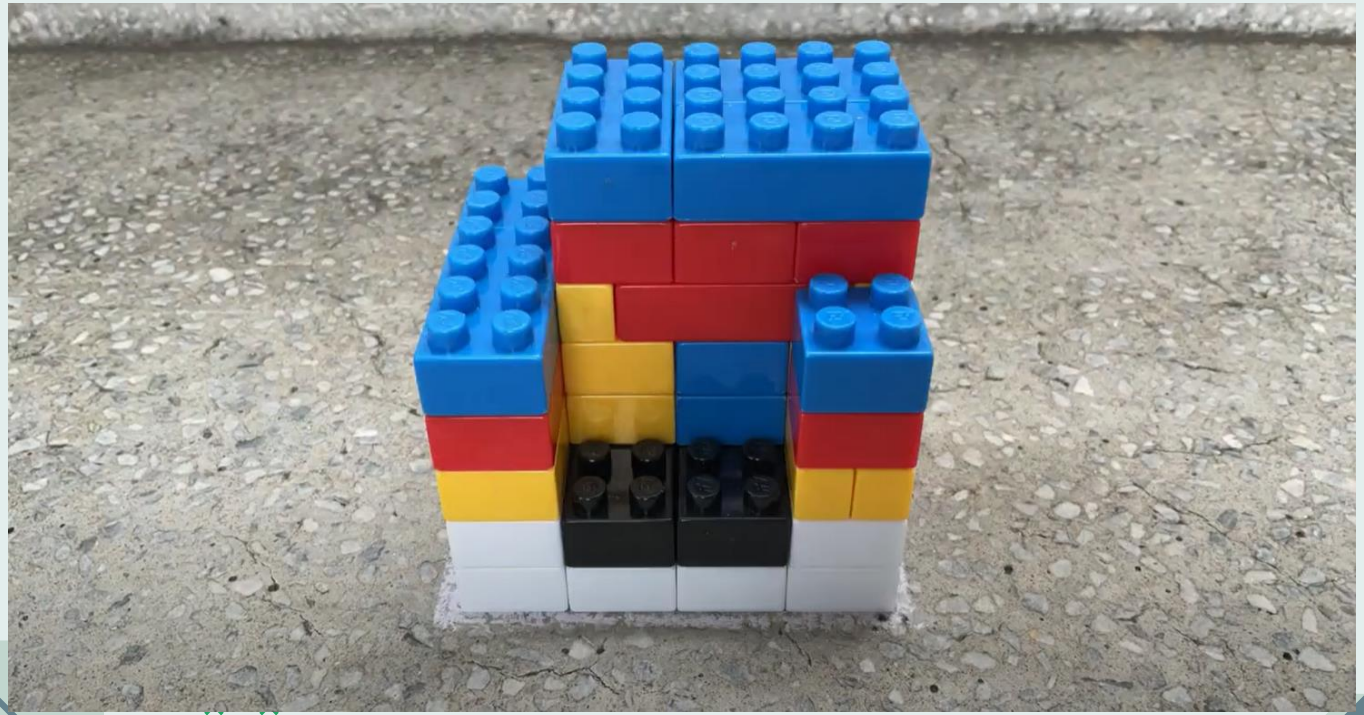

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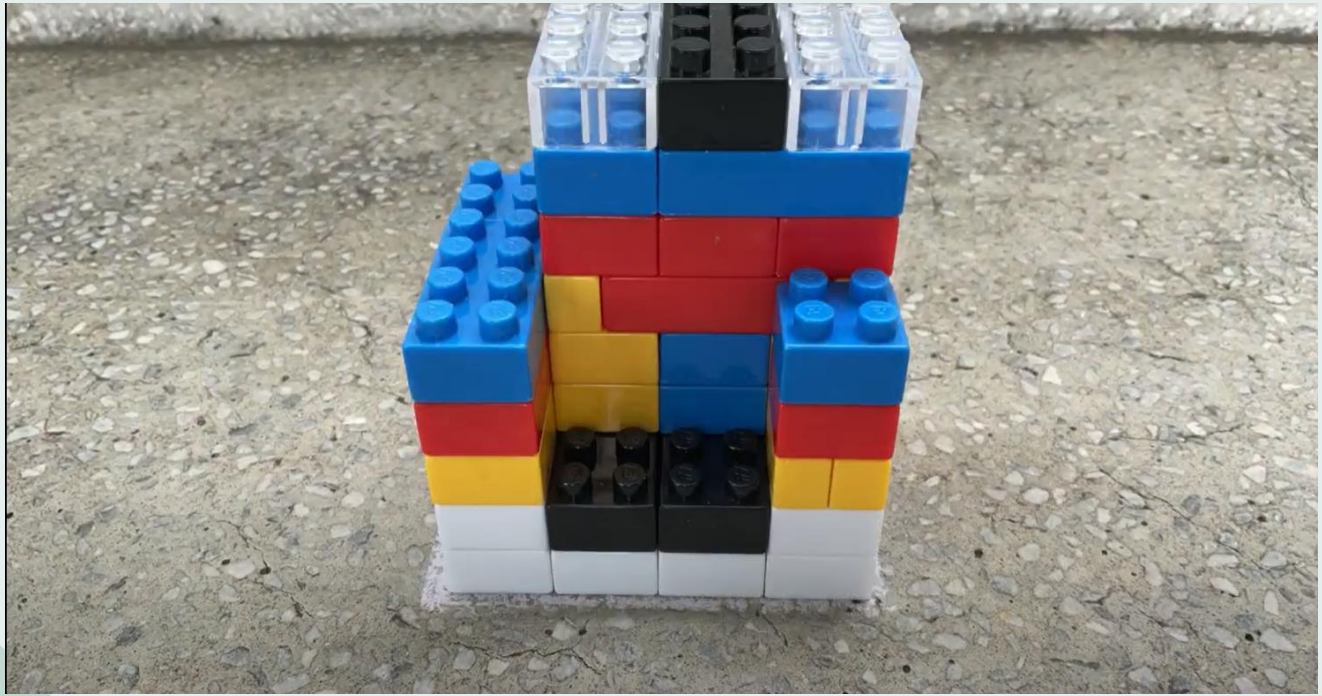

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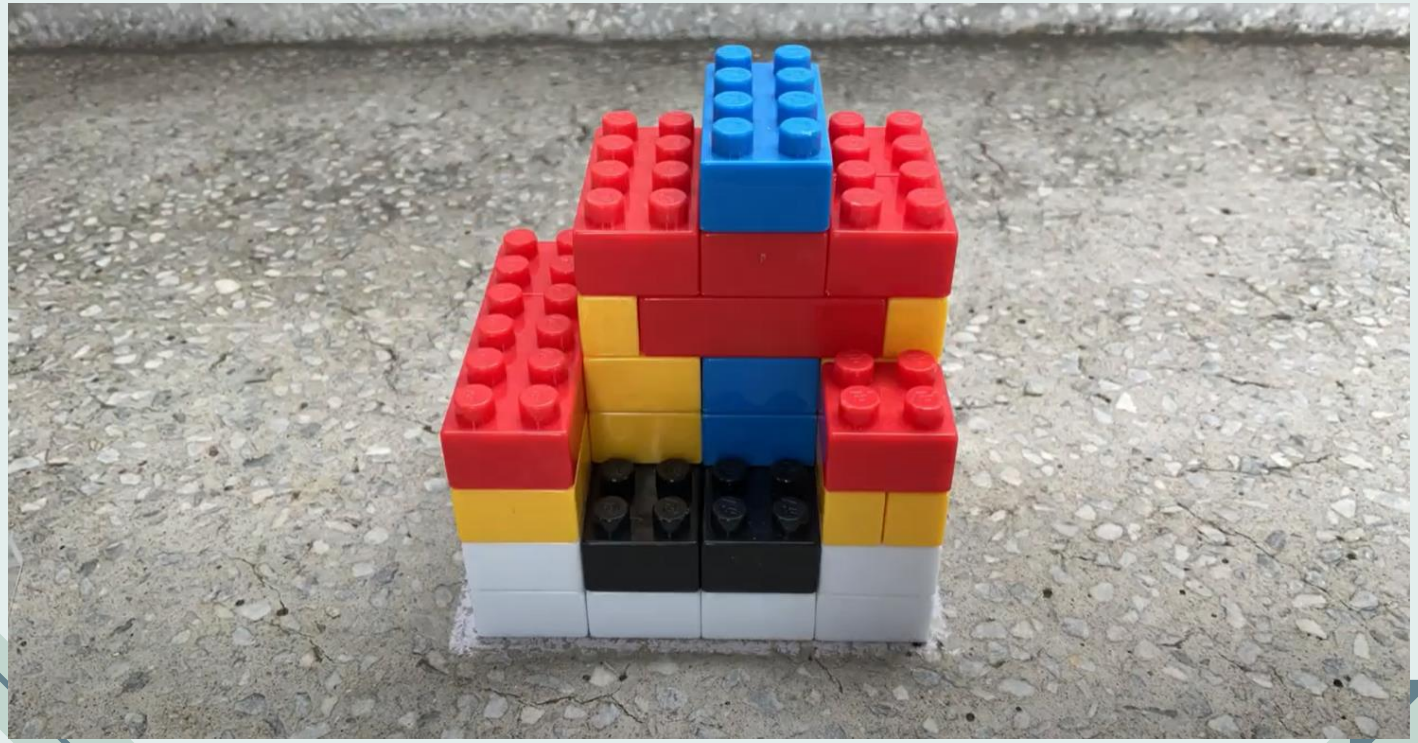

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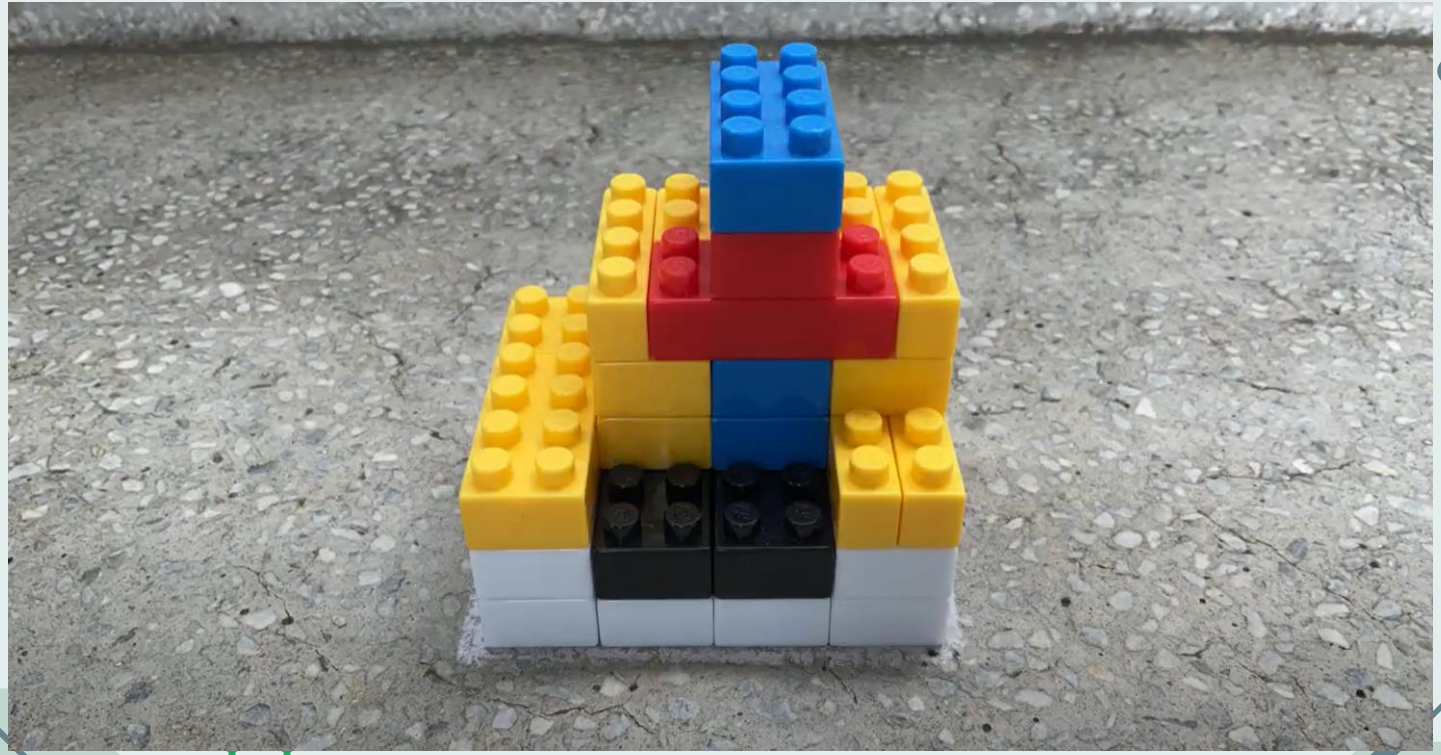

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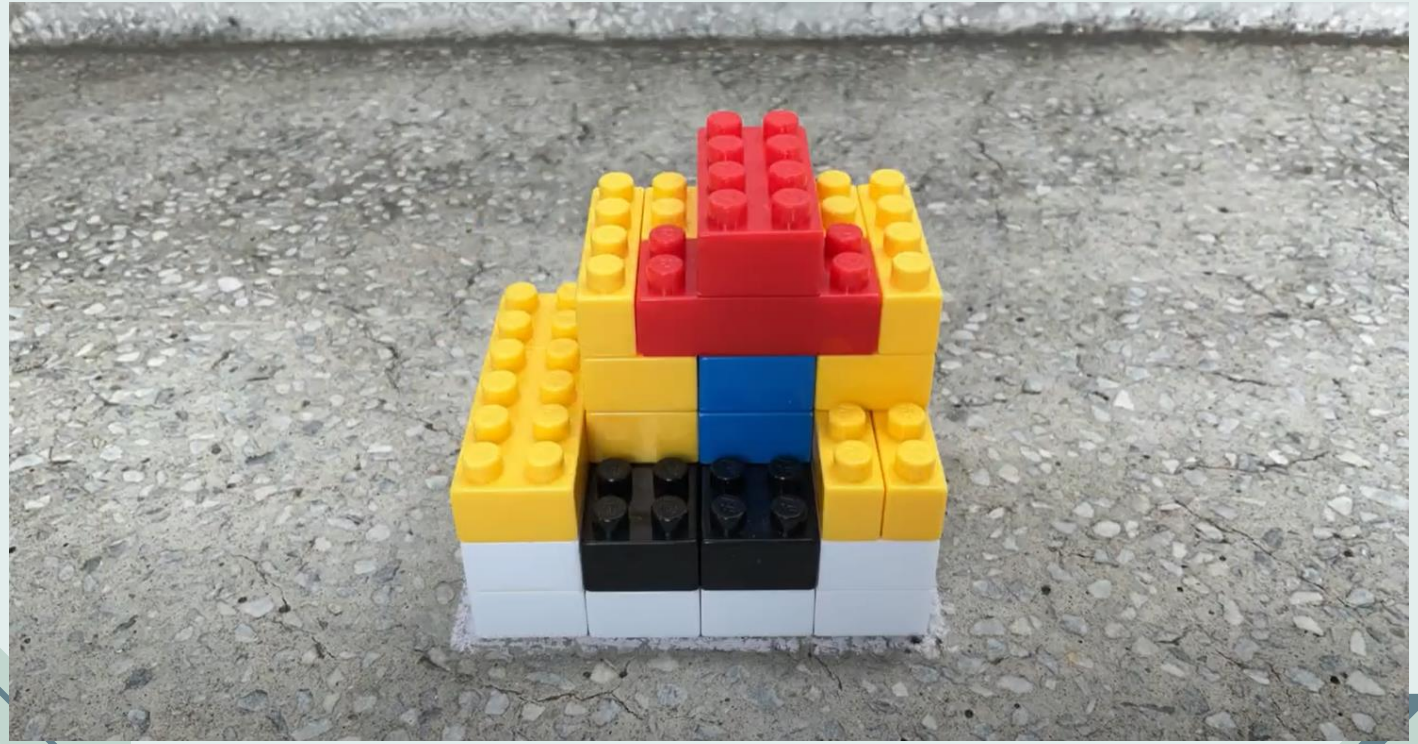

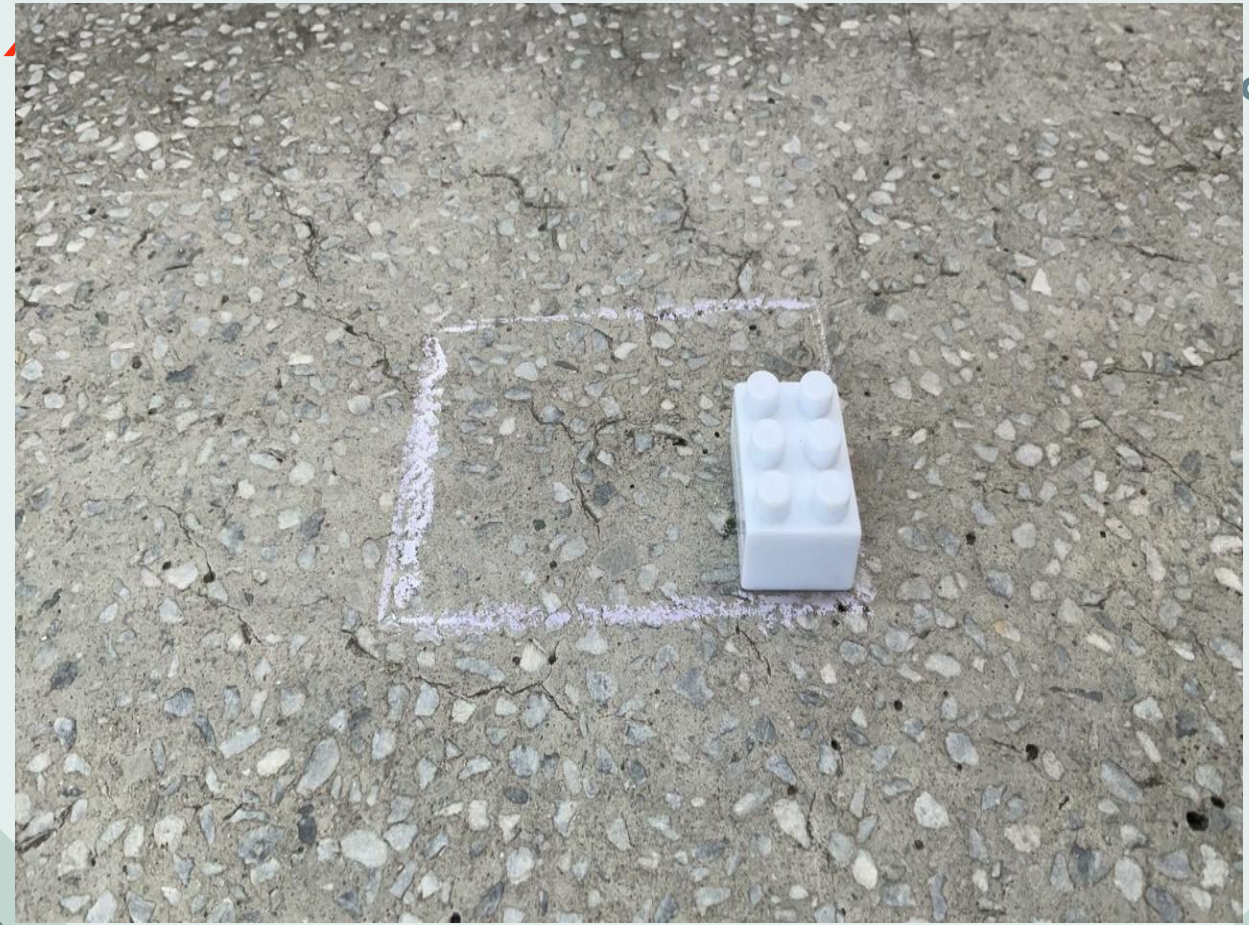

透過這些半導體製程就完成一個場效的電晶體了