

7th Annual E³S Retreat, 2017

Theme 1

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Theme 1 Leader

Center for Energy Efficient Electronics Science



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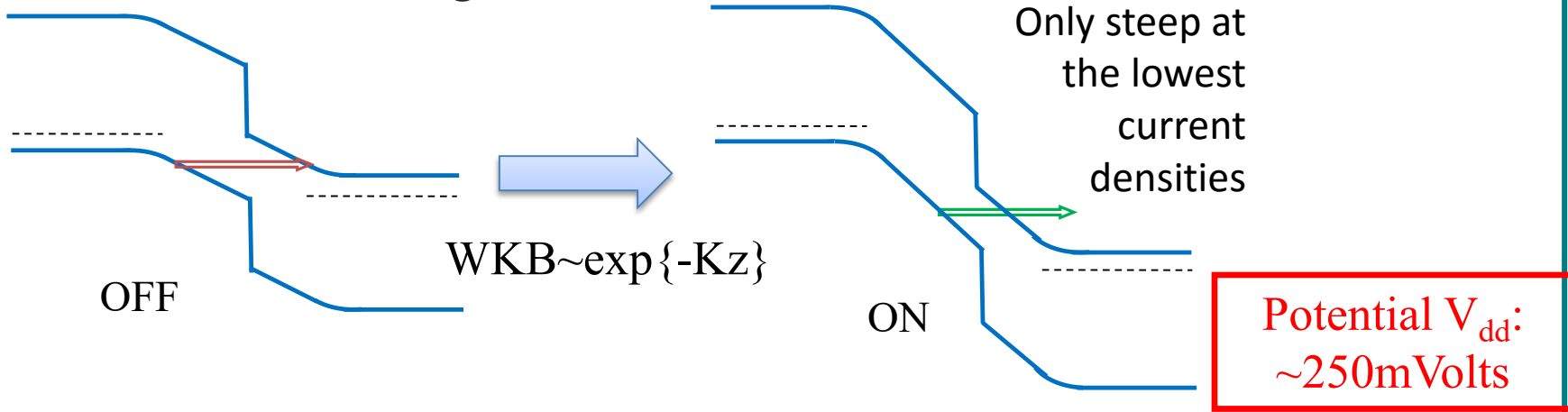
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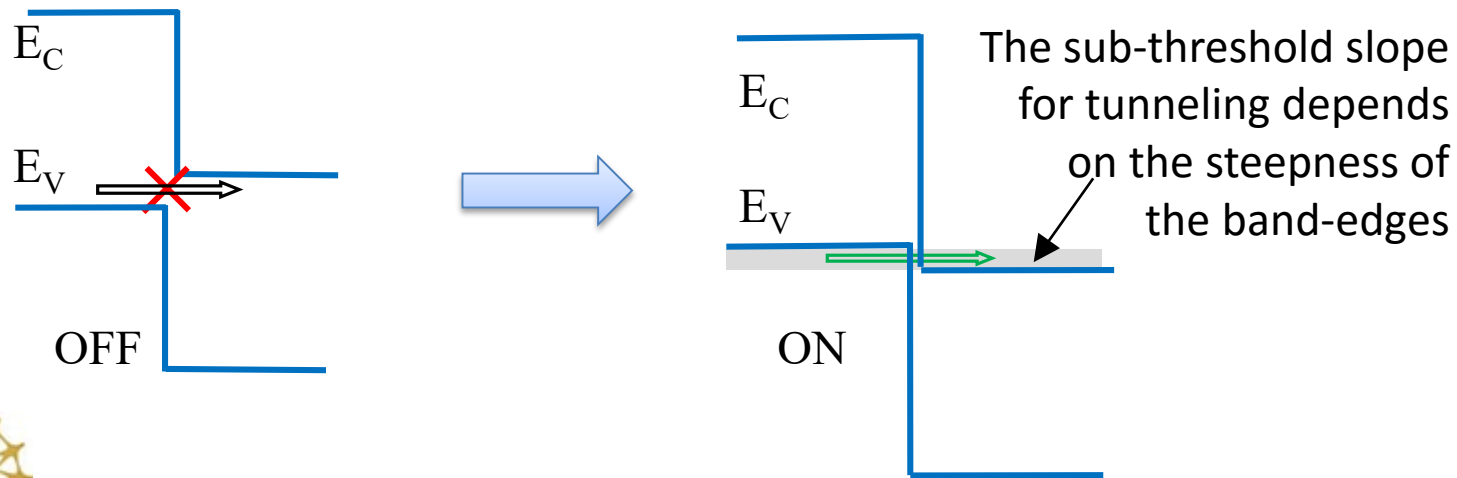
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2 Ways to Switch a Tunnel Field Effect Transistor:

➤ Modulate the Tunneling Barrier Thickness

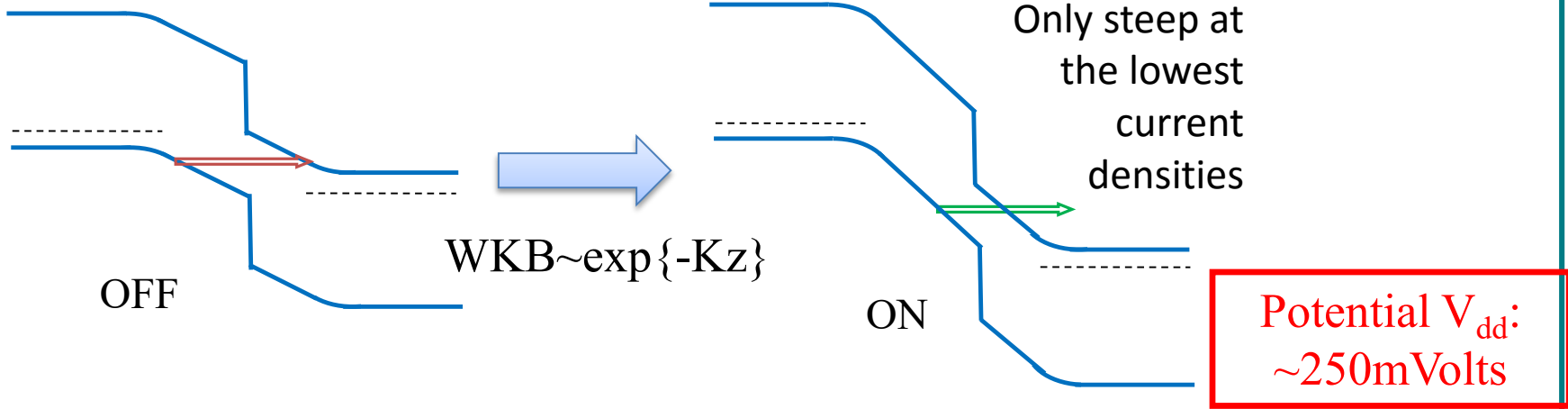


➤ Energy Filtering - Density of States Switch

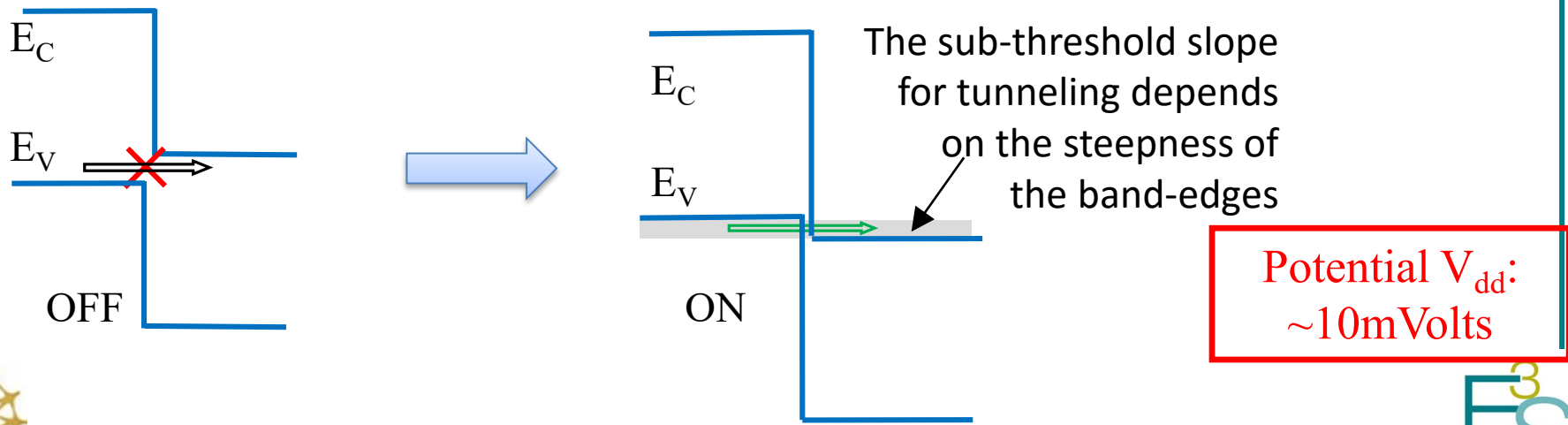


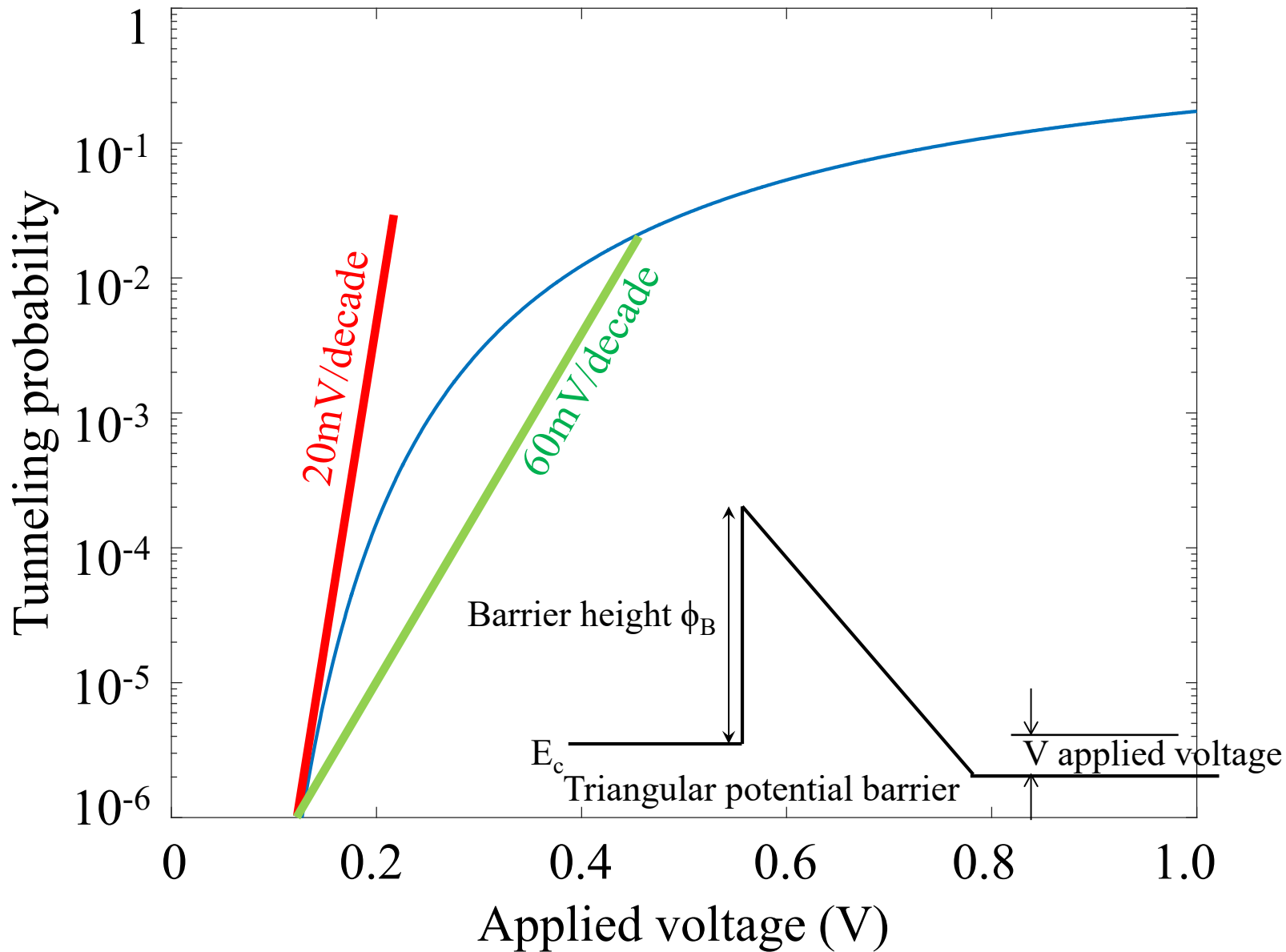
2 Ways to Switch a TFET:

➤ Modulate the Tunneling Barrier Thickness



➤ Energy Filtering - Density of States Switch

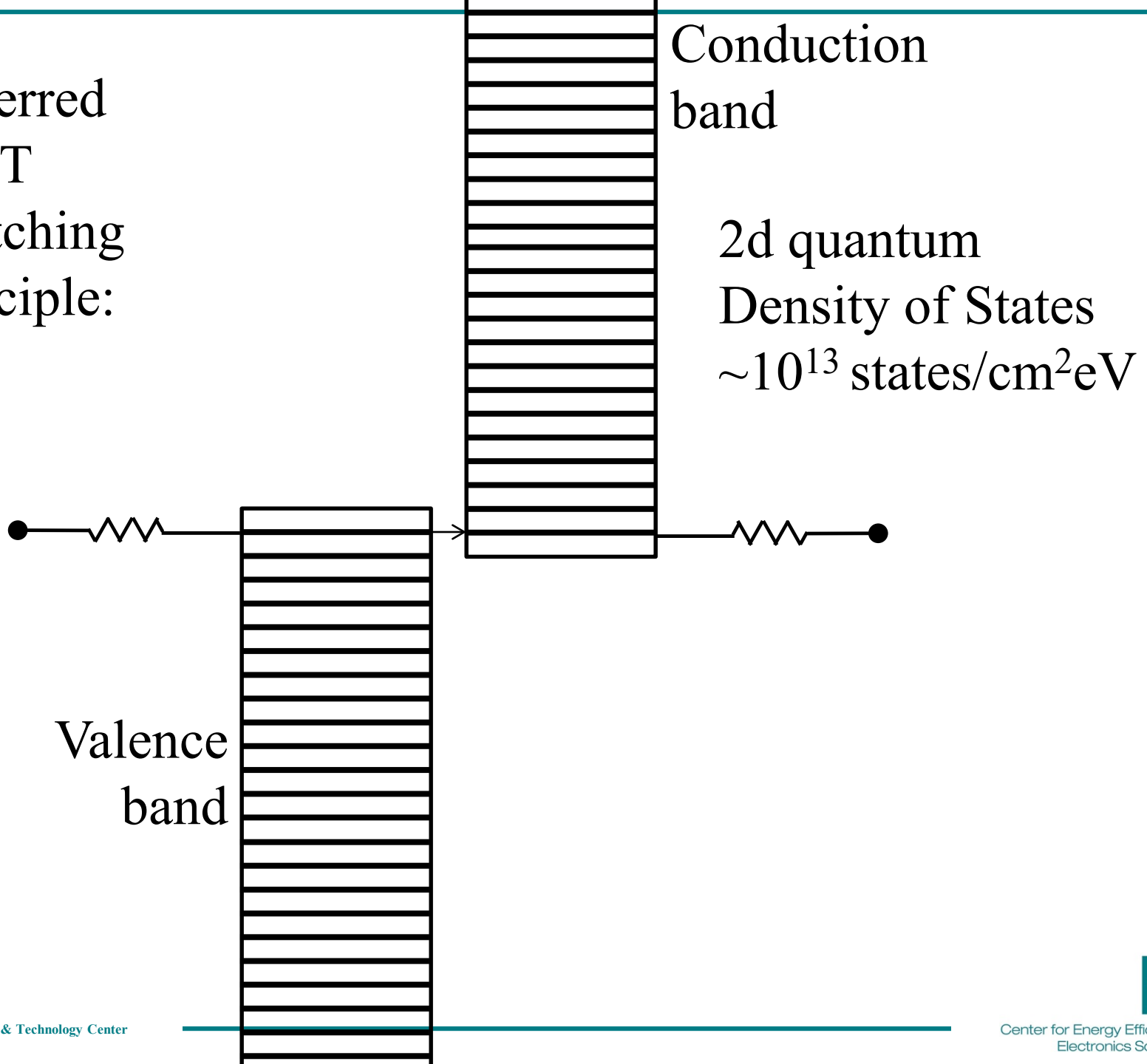




Tunneling probability through 10 nm InAs bilayer TFET, vs. voltage applied across bilayer



Preferred
TFET
Switching
Principle:



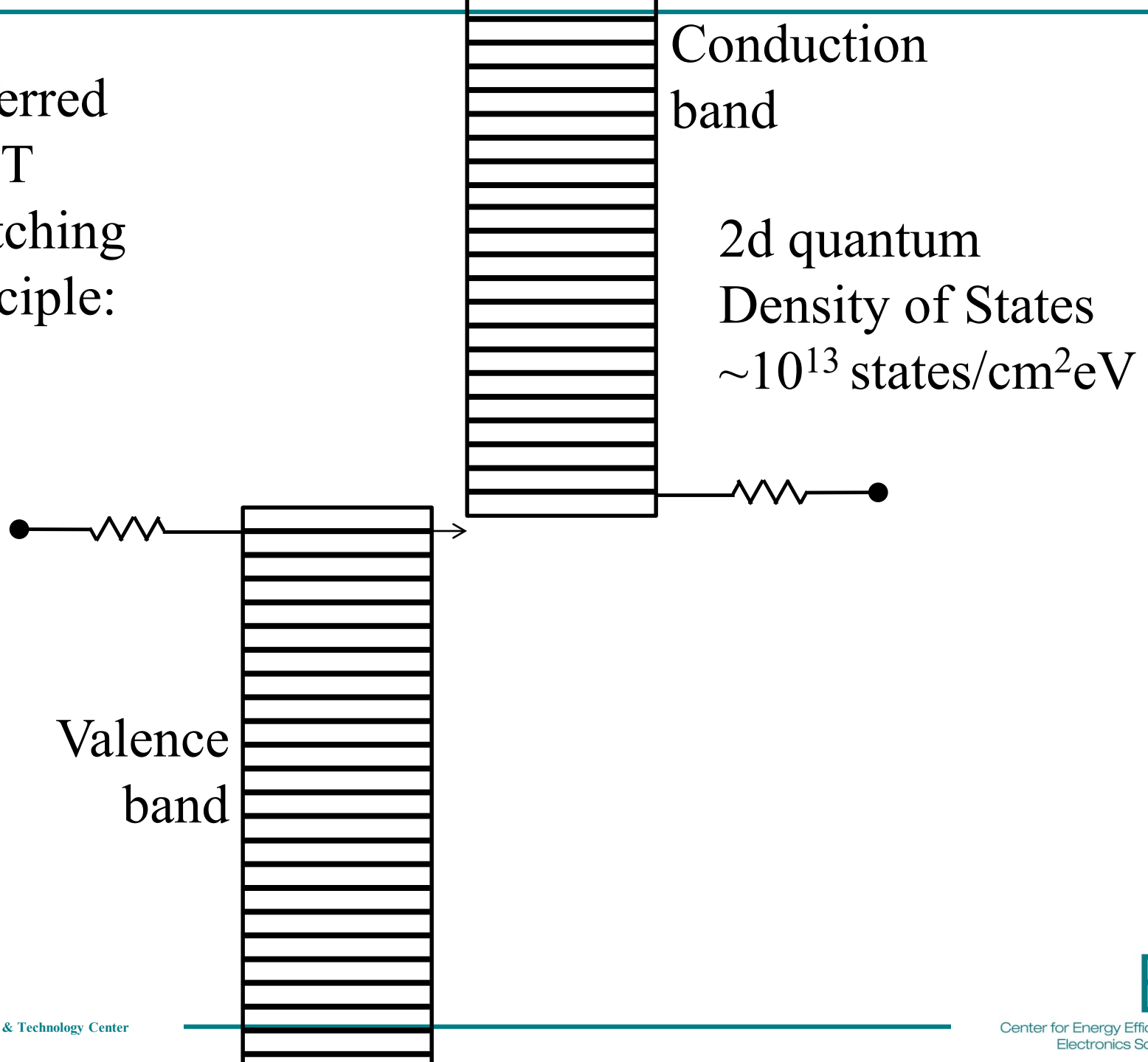
Conduction
band

2d quantum
Density of States
 $\sim 10^{13}$ states/cm²eV

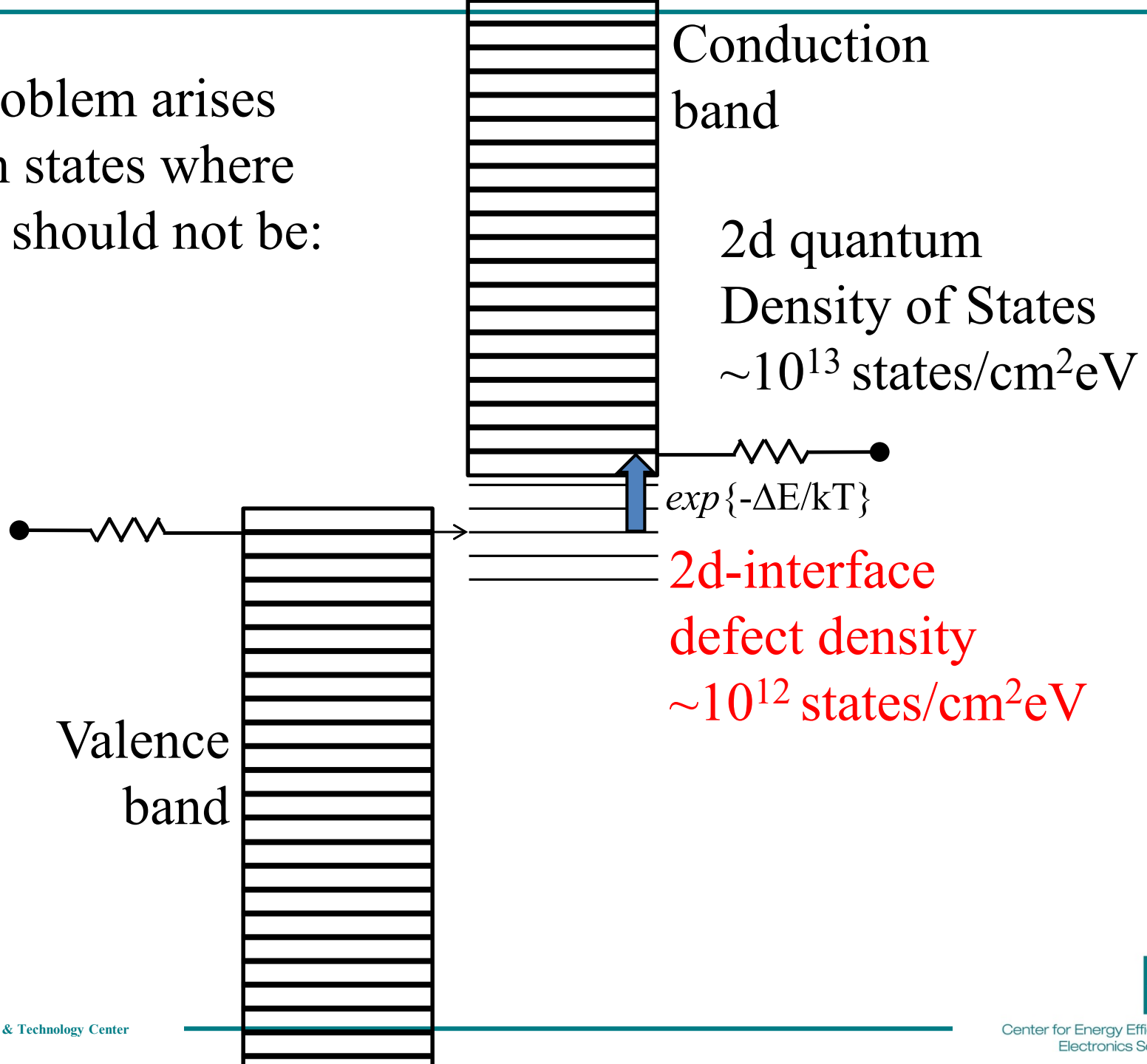
Valence
band



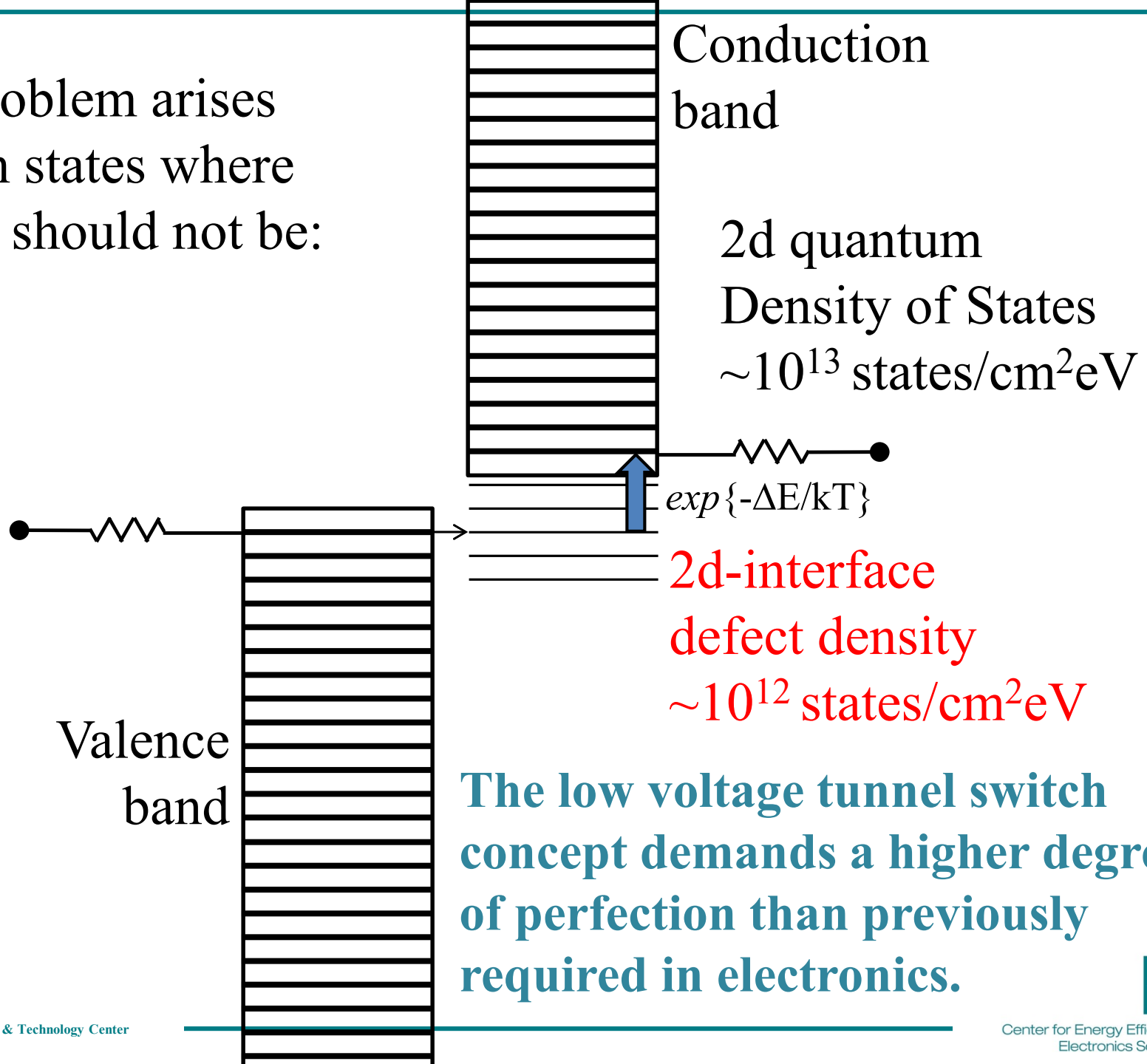
Preferred
TFET
Switching
Principle:



A problem arises from states where they should not be:



A problem arises from states where they should not be:



The low voltage tunnel switch concept demands a higher degree of perfection than previously required in electronics.



The message is finally getting through:

NANO LETTERS

Letter

pubs.acs.org/NanoLett

Individual Defects in InAs/InGaAsSb/GaSb Nanowire Tunnel Field-Effect Transistors Operating below 60 mV/decade

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Received: April 7, 2017

Revised: May 28, 2017

Published: June 14, 2017



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4373

DOI: 10.1021/acs.nanolett.7b01455
Nano Lett. 2017, 17, 4373–4380



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Solutions:

- ❑ It is possible to cure defects in monolayer semiconductor films using chemical reagents.
- ❑ Apply the knowledge we have learned on surface repair/passivation to t-FET's.



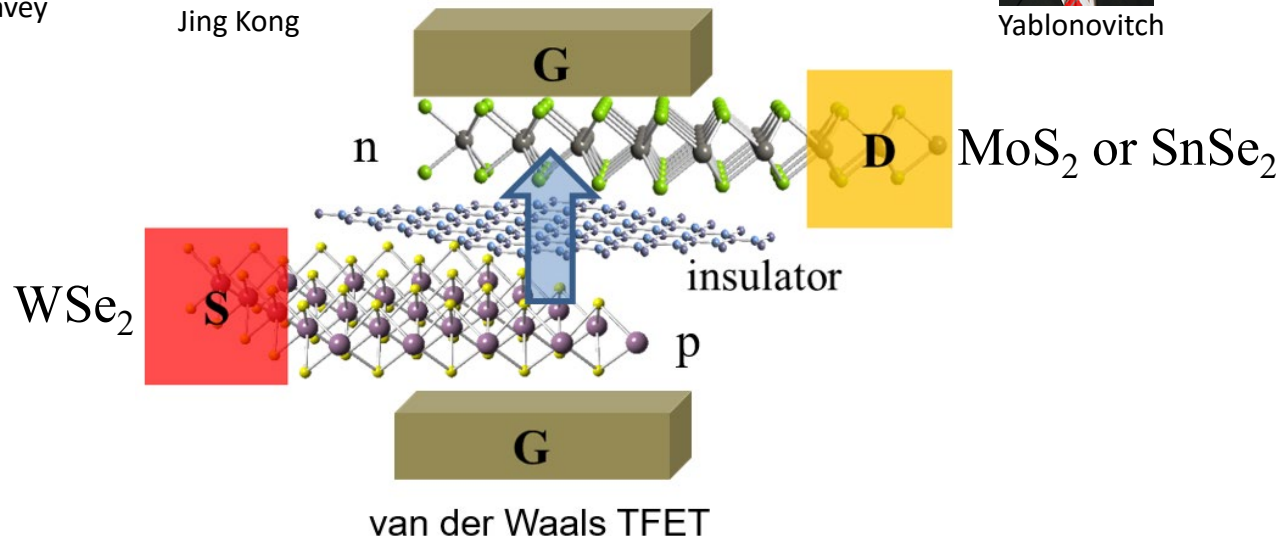
Javey



Jing Kong



Yablonovitch



A much more chemical approach is needed

- We are placing attention squarely on novel materials systems capable of producing the most perfect molecular scale device structures, that will be a pre-requisite for future progress.

- molecular synthesized structures

**Bottom-Up
Synthesis of
Atomically
Defined
Graphene
Nano-
Ribbon
Devices**



Fischer



Louie

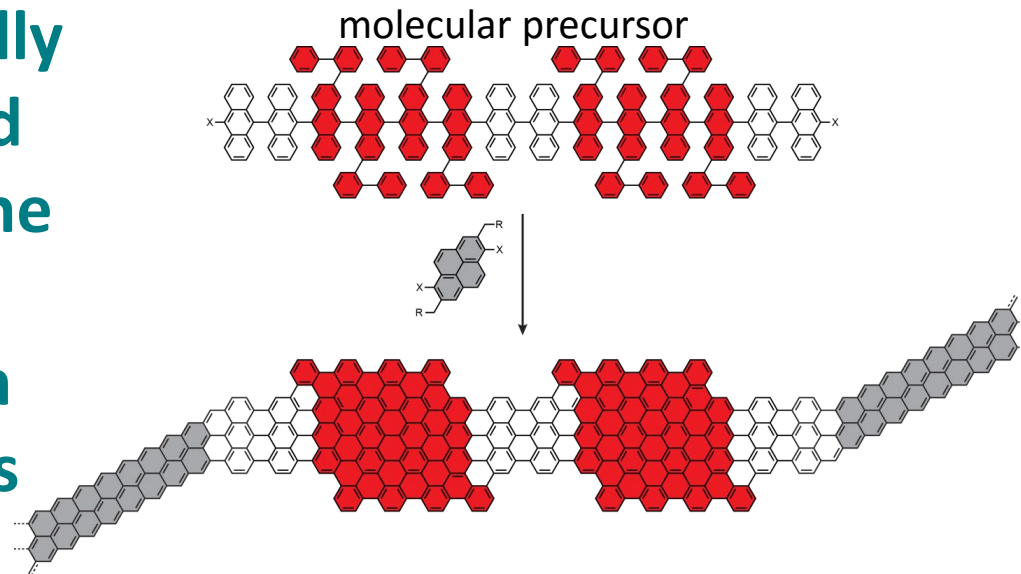


Bokor



Yablonovitch

**Prof. Felix Fischer
Prof. Steven Louie
Prof. Jeff Bokor
Prof. Eli Yablonovitch**



1/12/2017

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2017 NSF Reverse Site Visit

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