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# LECTURE 6

## EXTRINSIC SEMICONDUCTOR

ADDING IMPURITIES TO CONTROL ELECTRICAL PROPERTIES

* IMPURITY ATOMS WILL REPLACE HOST ATOMS

1) DONORS → INCREASES THE ELECTRON CONCENTRATION IN CB

2) ACCEPTORS → INCREASES THE HOLE CONCENTRATION IN VB

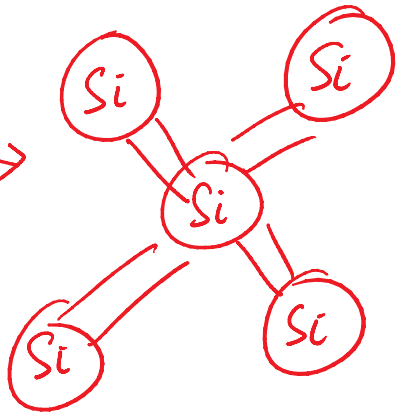
# DONORS

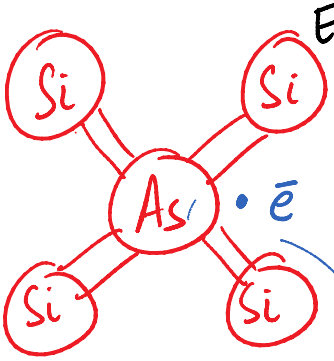
PURE SEMICONDUCTOR MATERIAL FROM COLUMN IV → ELEMENTAL SEMICO. Si

DONOR IMPURITY → COLUMN V

As → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^3$

5 VALENCE ELECTRONS




• $\bar{e}$ ADDITIONAL ELECTRON

LOOSLEY BOUND TO THE HOST ATOM

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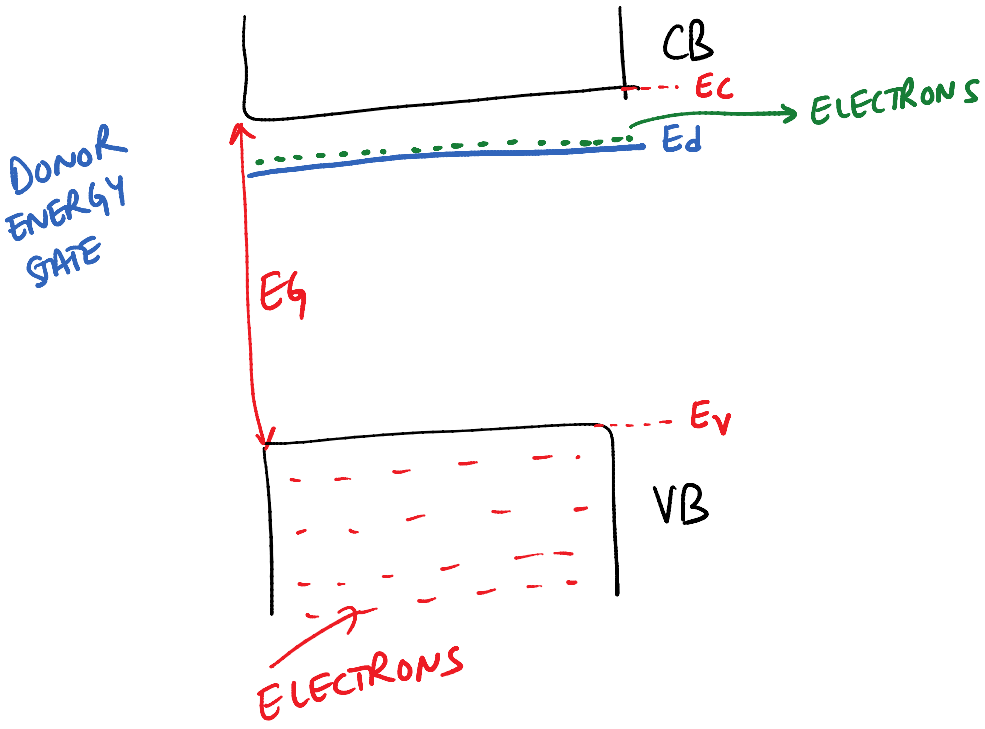


T= 0°K
INSULATOR

RT → THERMAL EXCITATION, EHP GENERATION FOR INTRINSIC SEMICONDUCTOR

FOR EXTRINSIC SEMICONDUCTOR
DOPED WITH DONOR IMPURITY
$(E_c - E_v) > (E_c - E_d)$

ADDING IMPURITY!

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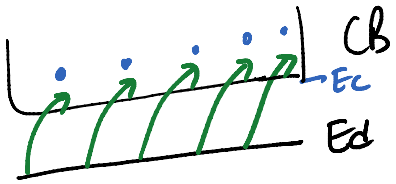
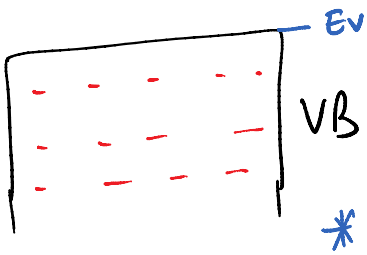
AT 50° K



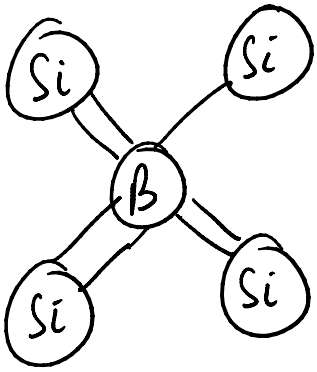

* NO TRANSITION FROM VB TO CB

* ADDING DONOR IMPURITY WILL ONLY LEAD TO n-TYPE OF SEMICONDUCTOR
  → ELECTRON IS THE MAJORITY CARRIER OF CURRENT

# ACCEPTORS

PURE SEMICONDUCTOR Si (COLUMN IV)

COLUMN III SEMICONDUCTORS FORM ACCEPTOR IMPURITIES

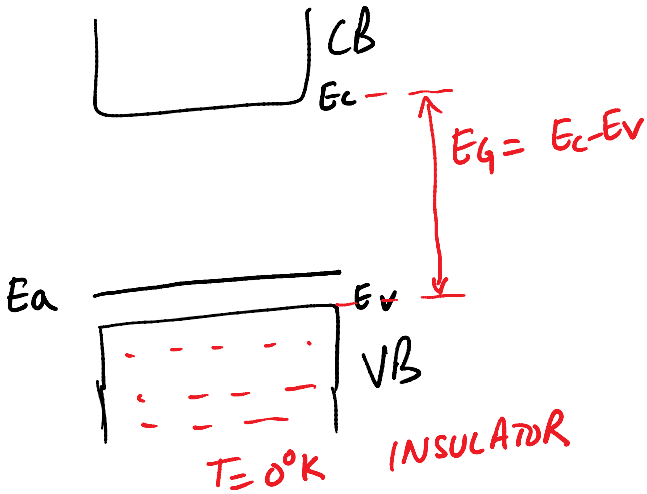



$(E_a - E_v) < (E_c - E_v)$

B

$1s^2\ 2s^2\ 2p^1$

3 VALENCE ELECTRONS



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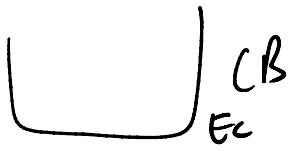
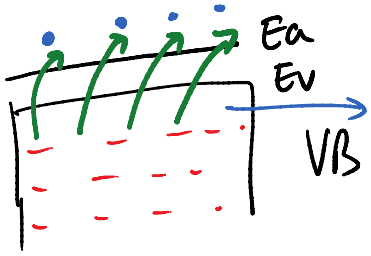
$T = 50°K$




"MISSING ELECTRONS"

* NO TRANSITION FROM VB TO CB

* SEMICONDUCTORS DOPED WITH ACCEPTOR IMPURITY LEADS TO A P-TYPE SEMICONDUCTOR

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HOLES ARE THE MAJORITY CURRENT CARRIERS