The *p-n* Junction Diode in Breakdown

If reverse bias too large (i.e., $v_D < -V_{ZK}$), the **covalent** bonds within the depletion region will **break**.

Therefore, **free** electrons are created (i.e., **conductivity** σ goes from zero to very high).

Large electric field **and** high conductivity:

→ This means **high current** ($\mathbf{J} = \sigma \mathbf{E}$) !!

Attempts to decrease v_D past $-V_{ZK}$ instead just causes further breaking of covalent bonds (i.e., conductivity σ increases). Therefore $|i_D|$ increases while $v_D \approx -V_{ZK}$.

There are **two** mechanisms for breakdown.

1) **Zener Effect** – Covalent bonds break because of large **E**-field.

2) **Avalanche Effect** – Bonds break due to kinetic energy of drift current.