

# Tradition and Present Challenges

**1931**

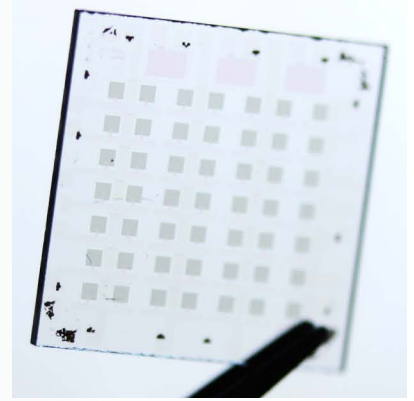
**Werner Heisenberg**  
quantum theory of holes as quasi-particles, explanation of p-type conductivity (together with R. Peierls, 1929)



**2016**

p-type oxide semiconductors, bipolar oxide devices, transparent solar cells

pss(a) **213**, 30-37 (2016)  
JVST B **34**, 04J107 (2016)  
J. Phys. D **49**, 213001 (2016)



**1925**

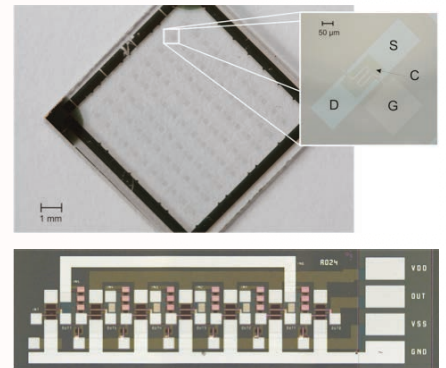
**Julius Edgar Lilienfeld**  
patents for all transistor types, MISFET, MESFET and JFET (filed in the US)



**2016**

oxide MESFET, oxide JFET, transparent transistors, oxide circuits

AEM **2**, 1500431 (2016)  
IEEE TED **62**, 4004 (2015)  
IEEE TED **62**, 3999 (2015)  
AEM **1**, 1400023 (2015)



**1907**

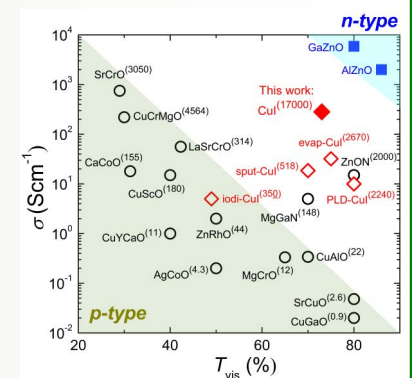
**Karl Wilhelm Bädeker**  
discovery of transparent, conductive materials and transparent conductive oxides, namely p-CuI and n-CdO



**2016**

p-type CuI as transparent conductive and thermoelectric material with highest figure of merit, pn-diodes, epitaxy

Nat. Comm. **8**, 16076 (2017)  
Sci.Rep. **6**, 21937 (2016)  
PNAS **113**, 12929 (2016)



**1887**

**Paul Drude**  
polarized reflection, optical axes in anisotropic crystals, optical axes in absorbing crystals (fully solved by W. Voigt, 1902)



**2016**

singular axes, exceptional points, Raman scattering in anisotropic crystals

PRL **116**, 127401 (2016)  
PRA **93**, 053839 (2016)  
PRB **94**, 035148 (2016)  
Sci. Rep. **6**, 35964 (2016)  
pss RRL **11**, 1600295 (2017)

