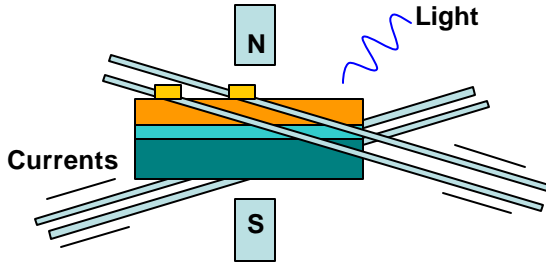


Spintronics and Diluted Magnetic Semiconductors

Spintronics, which combines the key advantages of **microelectronics** and **micromagnetics**, represents the New Frontier in Device Physics for **Future Integrated Circuit Technology**

: Needed :



Multi-Functional Magnetic Materials
with
High Spin Polarization

Most Carrier Spins preferring one direction over the other in applied magnetic field

One Interesting Possibility : Diluted Magnetic Semiconductors

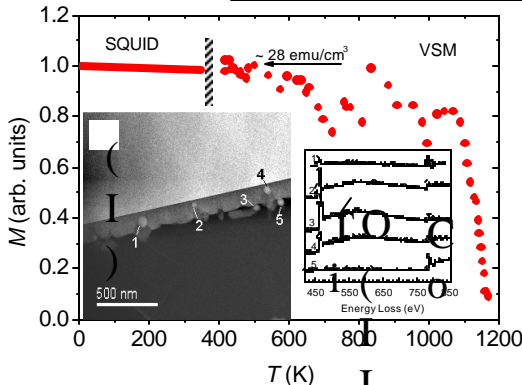
Semiconductors with Dilute Concentration of Magnetic dopants

Prior Successes with **CdMnSe, GaMnAs etc. (thin films)** Furdyana, JAP 64,R29, 98, Ohno, Science 281, 951, 98

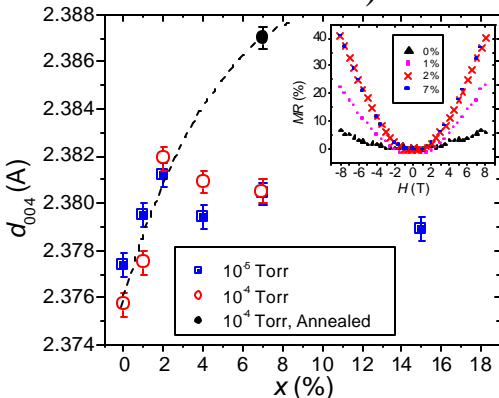
But No Ferromagnetism at or above room temperature

Recent Report of above room temp ferromagnetism in Anatase **Co:TiO₂**
Matsumoto et al Science 291, 854, 01

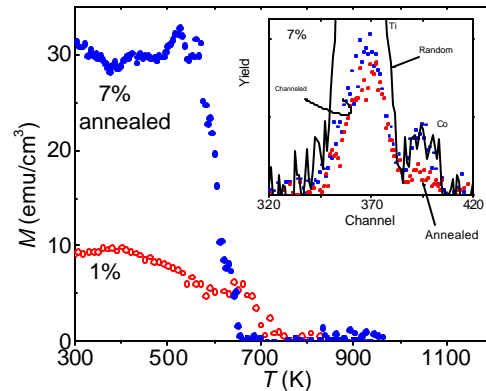
We used Pulsed Laser Deposition to grow anatase **Co:TiO₂**



We see Magnetization At 300K and above.
However, for $x > 2\%$, we see cobalt clusters.



The XRD and MR data suggest substitution of Co in TiO₂ for $x < 2\%$. Even in $x=7\%$ Film, Co goes to substitutional site when annealed at high T.



Cond-Mat
0203576

The magnetization data shows that when Co is substituted for Ti, $T_C \sim 700$ K. The inset shows the channeling behavior of 7% doped film after annealing.

CONCLUSION

Co substitutes in TiO₂ matrix either at low concentrations ($x < 2\%$) or after annealing at very high T (900 °C).

The Curie temperature of the true DMS is about 650 – 700 °C.

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Shinde, Ogale, Das Sarma, Lofland, Kulkarni, Sharma, Higgins, Greene, Venkatesan, Simpson, Drew, Millis