Terre Rare
Impieghi

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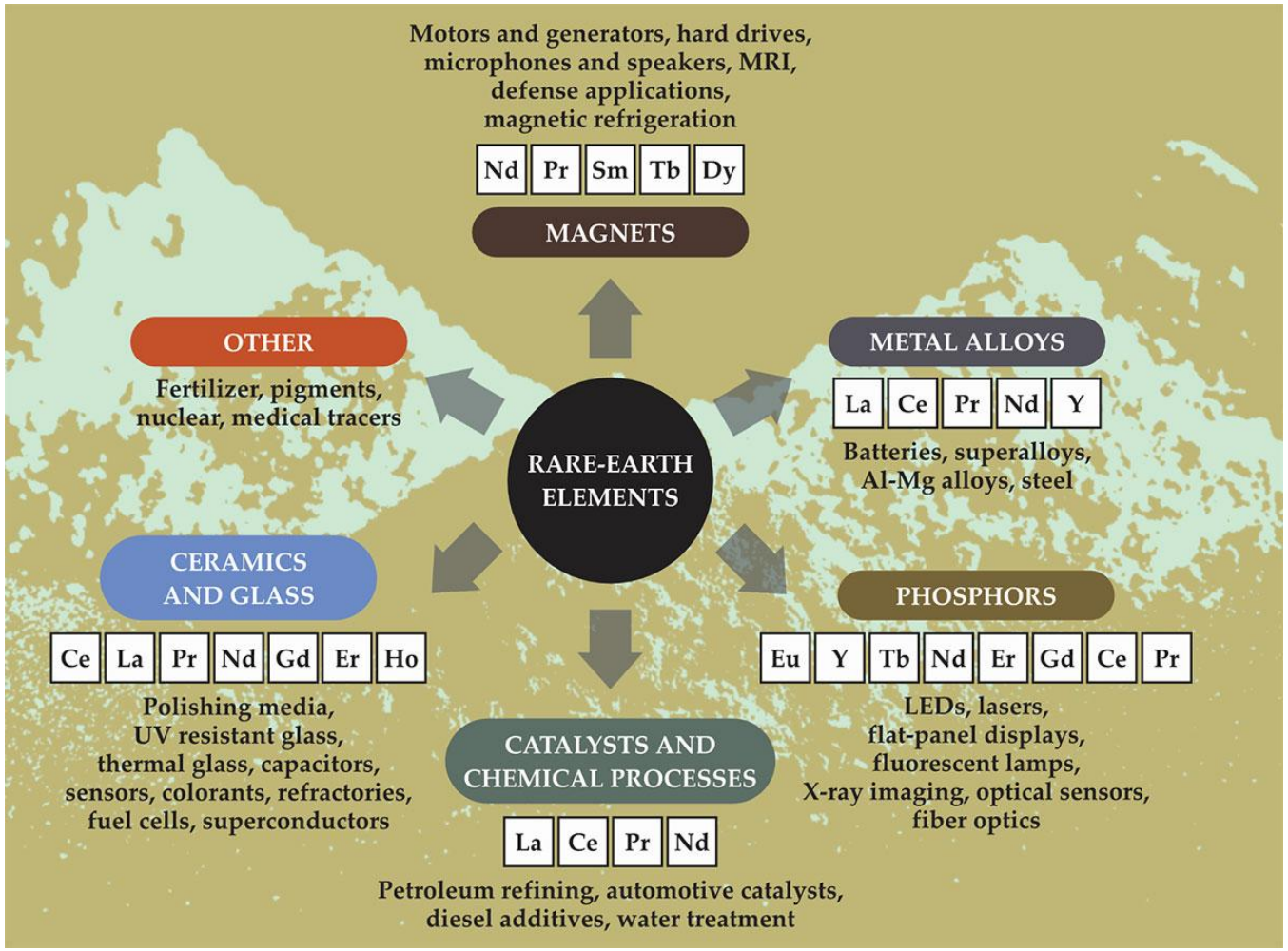
sommario



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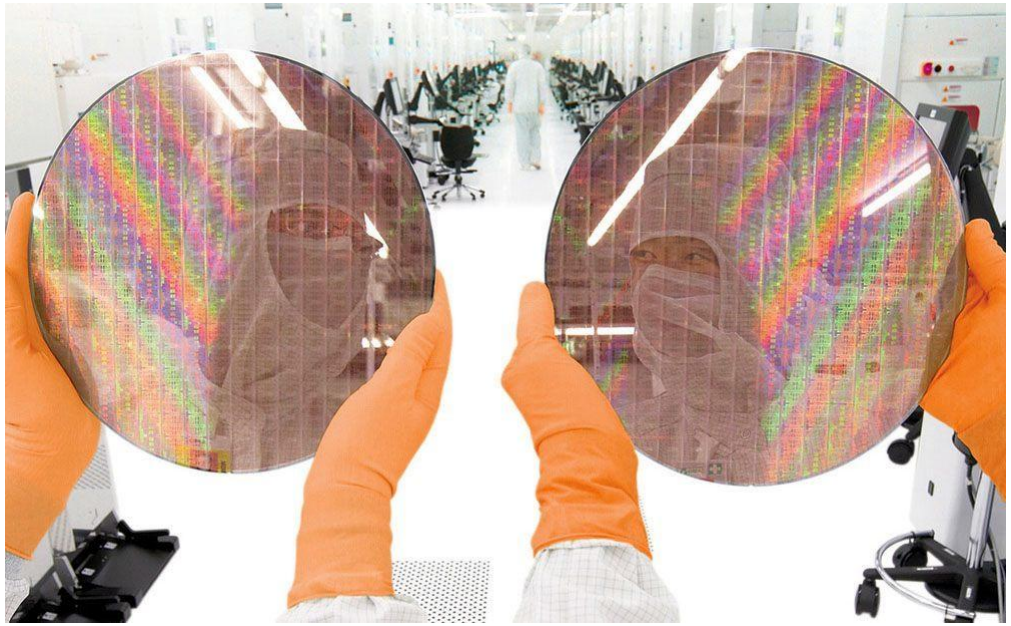
Le Terre Rare

1. Elettronica
2. Ottica
   I. fosfori
   II. Telecomunicazioni
3. Magneti
   I. Motori
   II. Generazione energia
4. Medicina

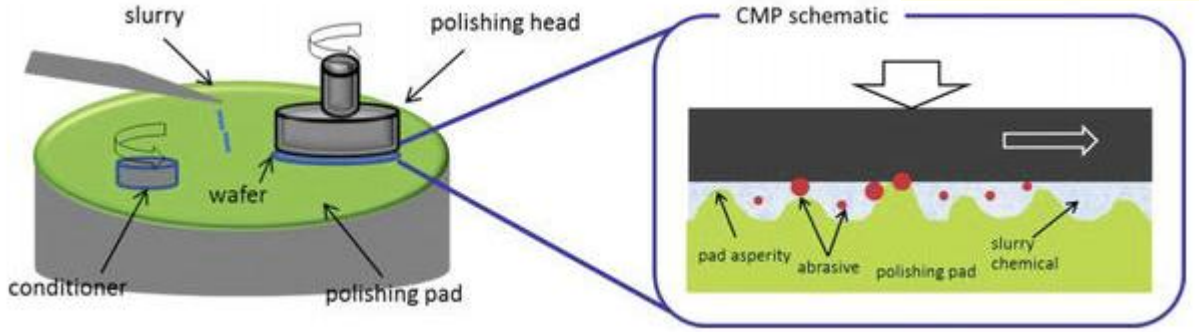
Elettronica

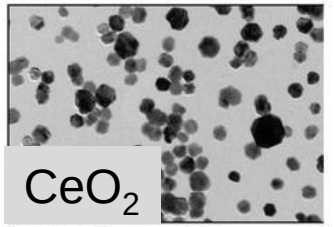


Altissima integrazione: dimensioni gate 5-7 nm

Chemical Mechanical Planarization (CMP)

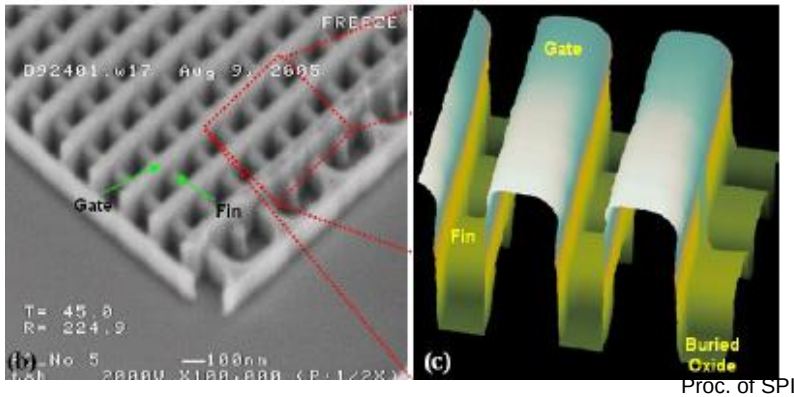
DOI: 10.5772/intechopen.75408





CeO_2

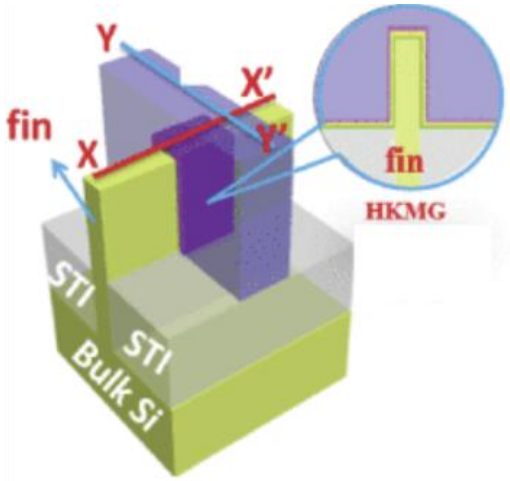
FINFET

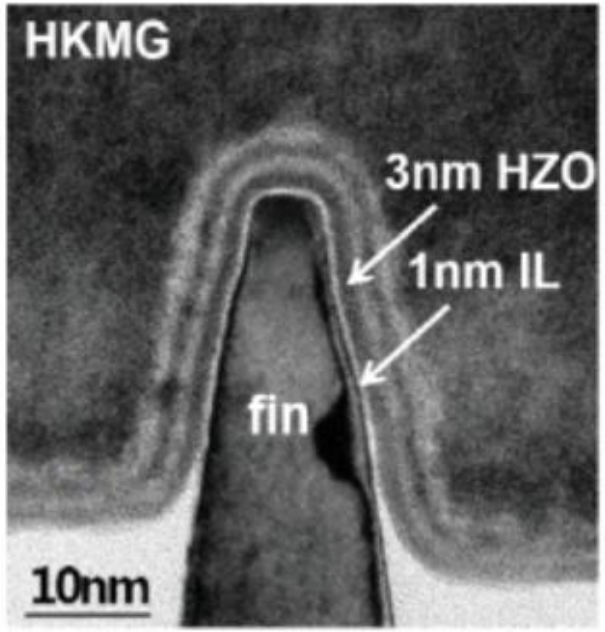


Proc. of SPIE Vol. 7272 72722R-5

Elettronica: Circuiti Integrati

FINFET



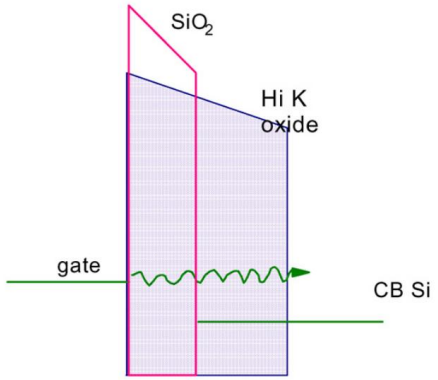


DOI: 10.1109/LED.2020.3048349

- Miniaturizzazione
- Velocità
- Minore consumo

Minore spessore ossido di isolamento

Correnti di dispersion in FET: una questione quantistica

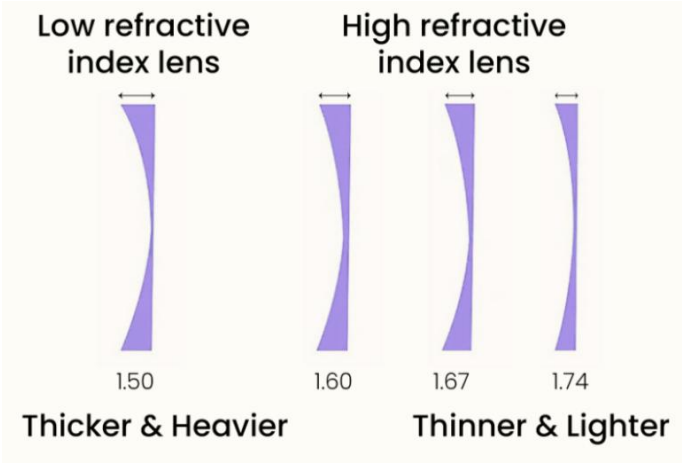


tunnel elettronico: dipende dallo spessore del dielettrico

Ossidi di TR hanno una costante dielettrica k elevata

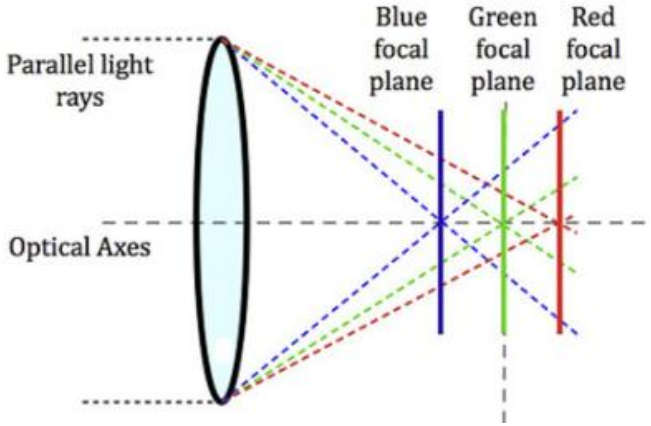
- Hafnium Oxide (HfO_2),
- Lanthanum Oxide (La_2O_3)
- LanthanumAluminum Oxide ($LaAlO_3$)

Vetri a base di Lanthanum

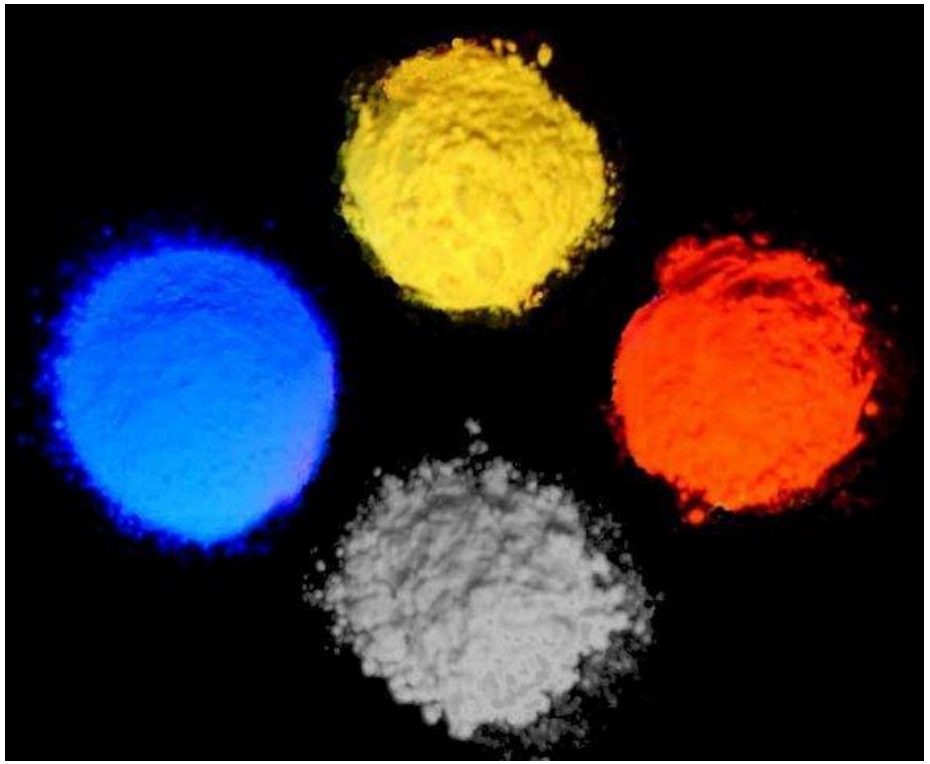


Vetri con una percentuale elevate di La_2O_3 hanno i seguenti vantaggi

Alto indice di rifrazione (n=1.8): Miniaturizzazione
Bassa dispersione cromatica: Chiarezza
Durezza: resistenza meccanica



Fosfori



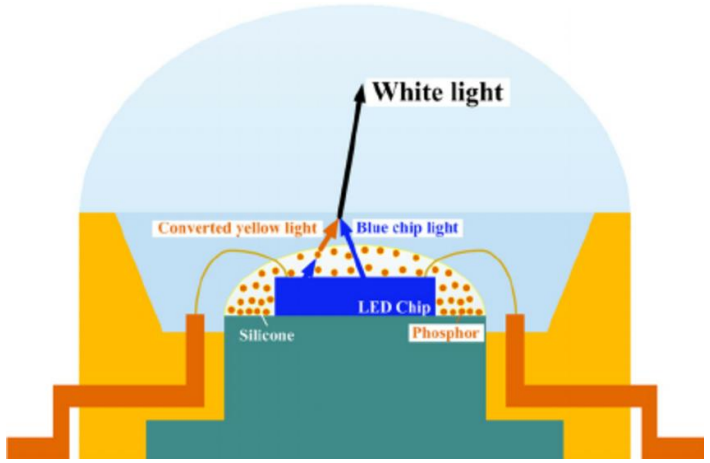
Colori
- Rosso: europio
- Verde: terbio o gadolinio
- Blu: europio bivalente
- Giallo: cerio

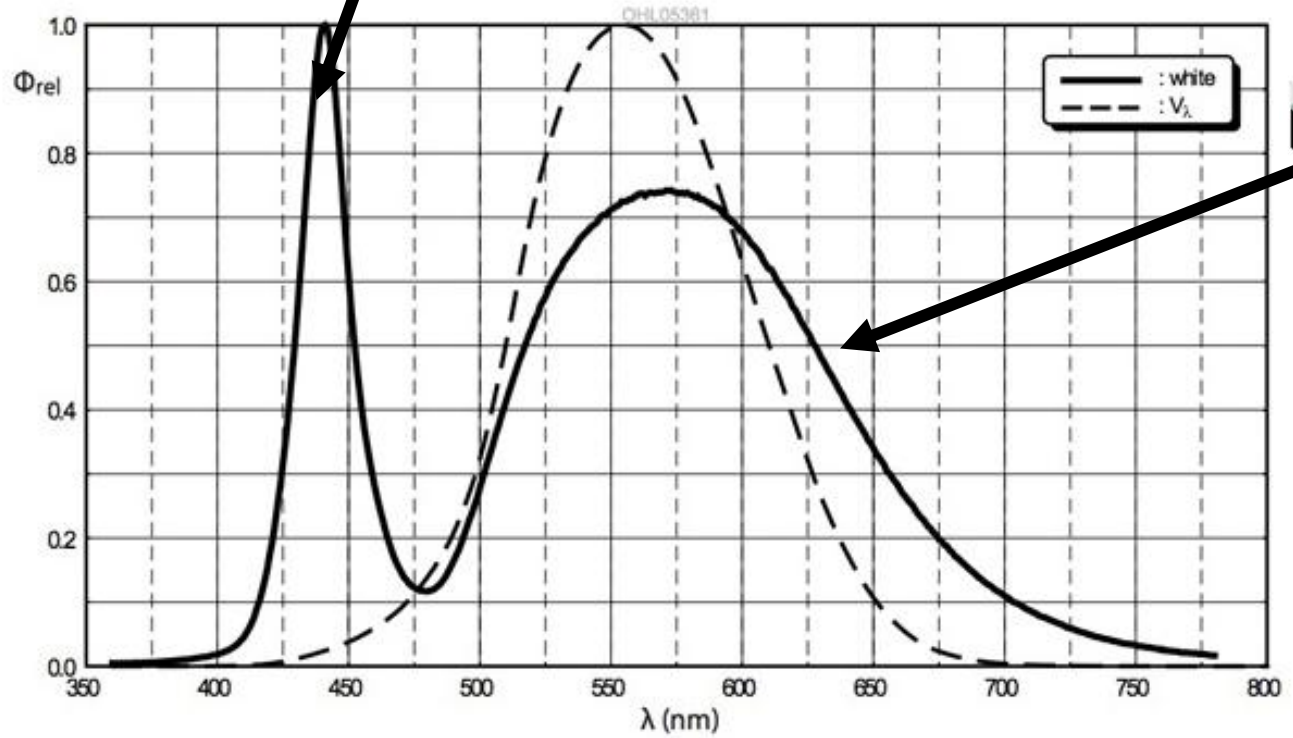
Applicazioni principali
- Illuminazione: LED bianchi e lampade fluorescenti, schermi LCD
- Ottica specializzata: laser e fibre ottiche

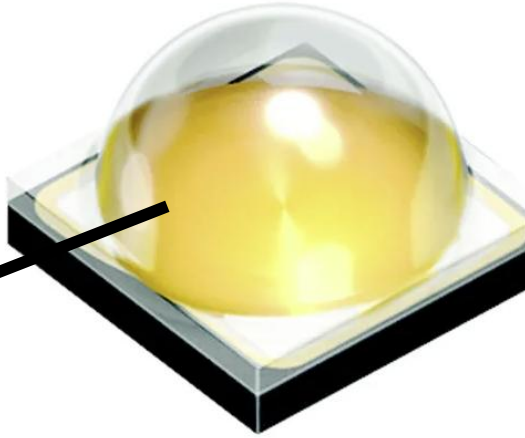
Vantaggi
- Elevata efficienza
- Stabilità
- Purezza del colore

LED Bianco

LED Blu + Fosfori Gialli (Cerio)

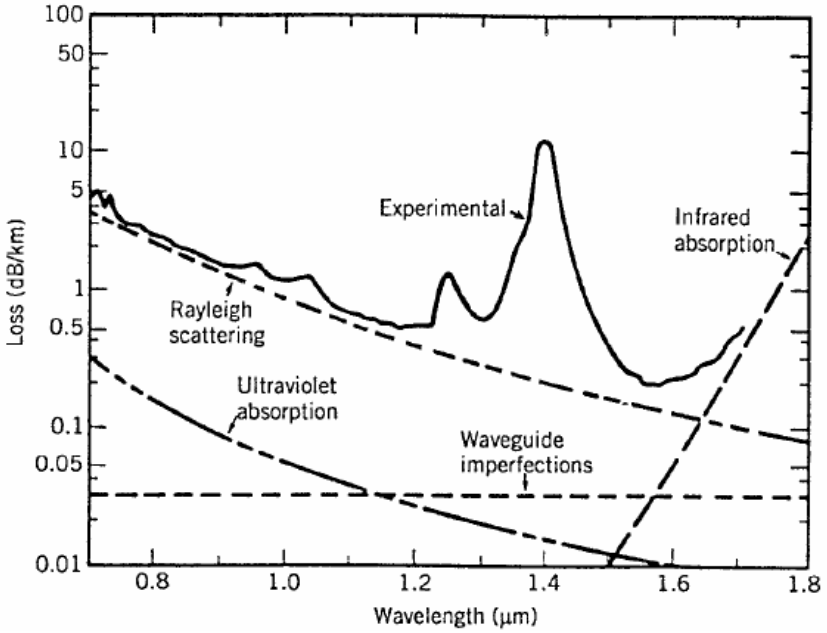






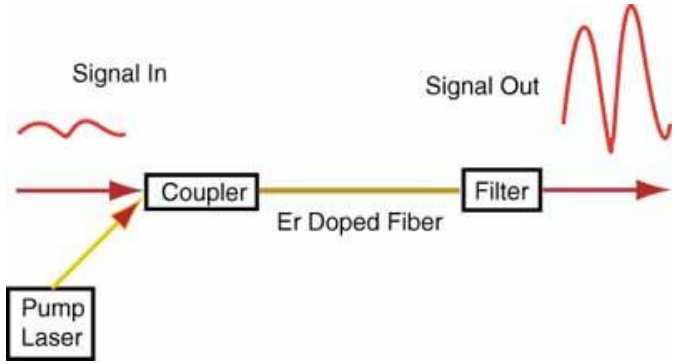
Telecomunicazioni

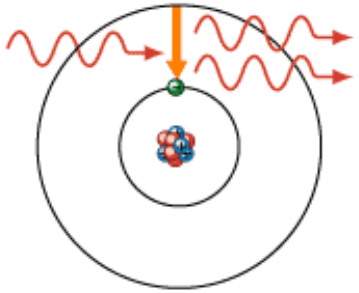
Lunghezza d'onda ottimale 1550 nm: emissione Erbio



Ogni 80 km il segnale deve essere amplificato

Erbium Optical Amplifiers





stimulated emission

Magneti permanenti

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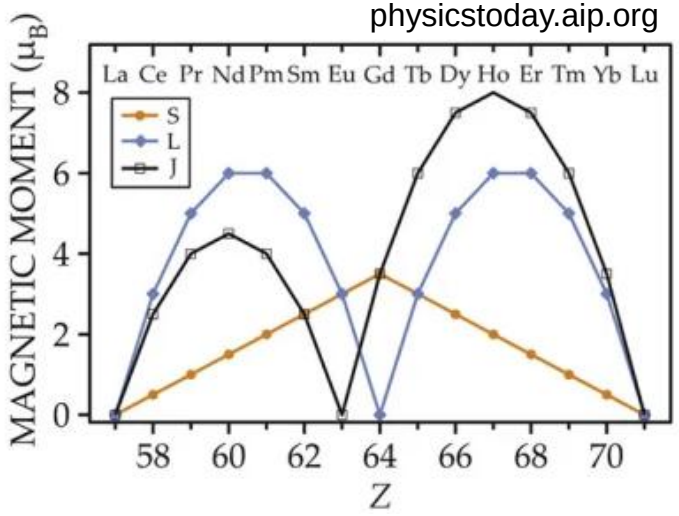
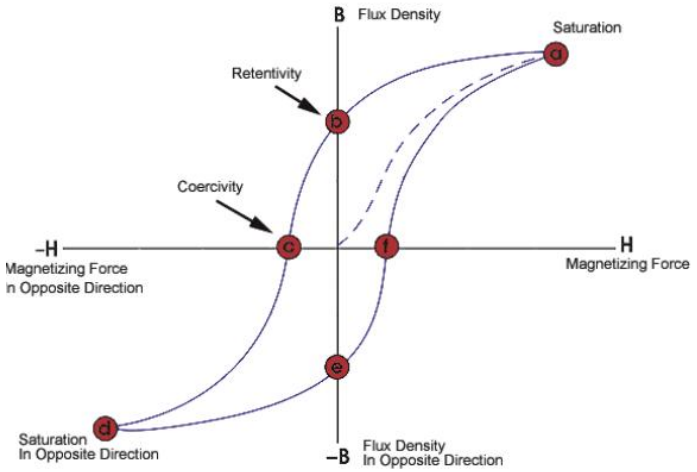
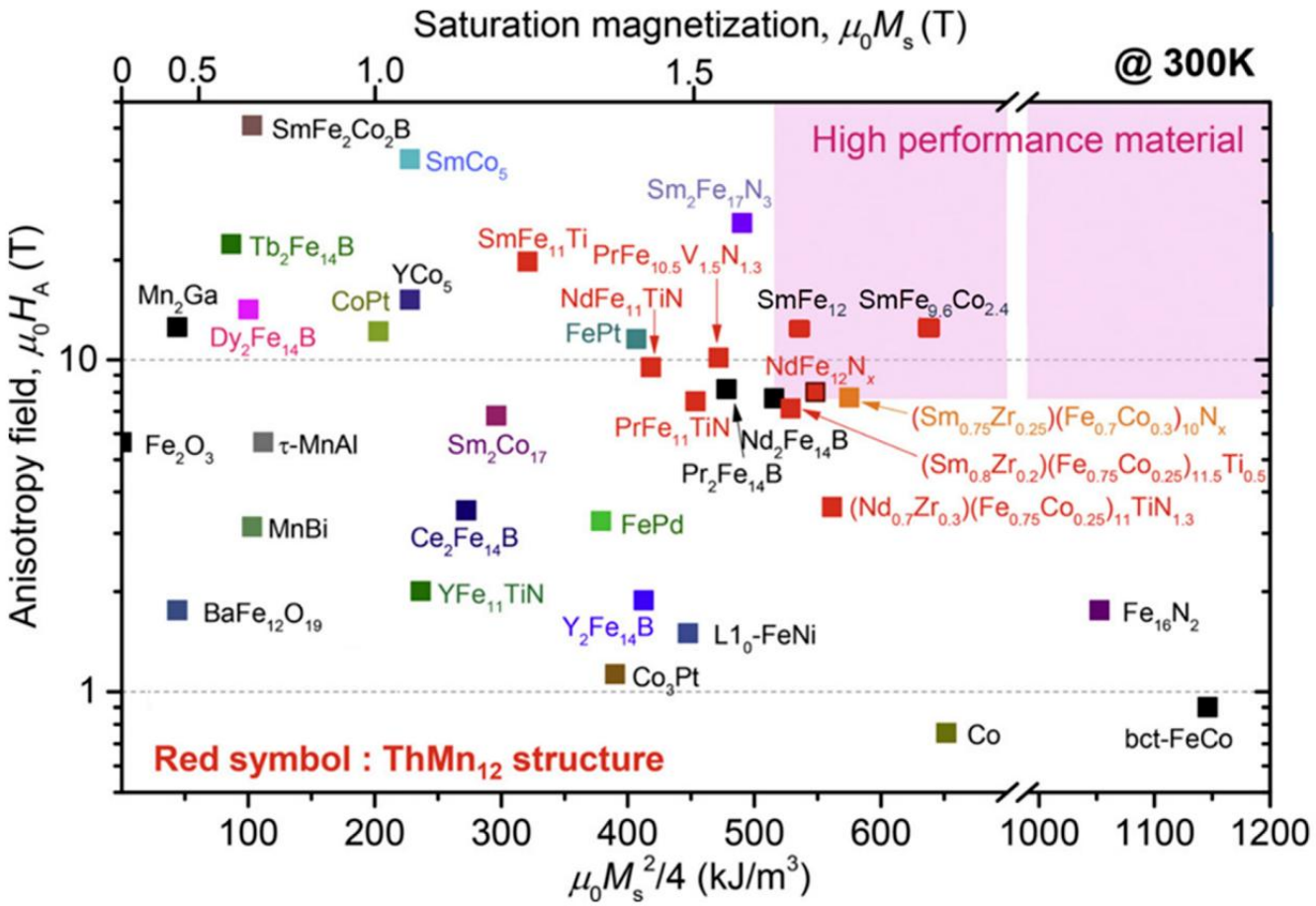






Magneti al Neodimio

Composizione: $Nd_2Fe_{14}B$

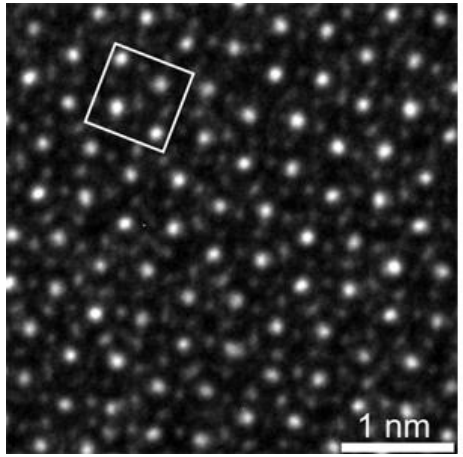
$J_s \approx 1.6$ Tesla

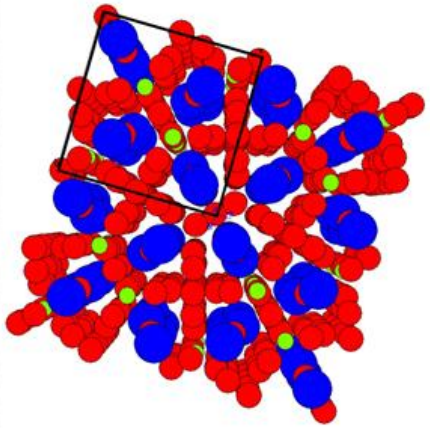
$BH_{max} \approx 512$ kJ/m^3

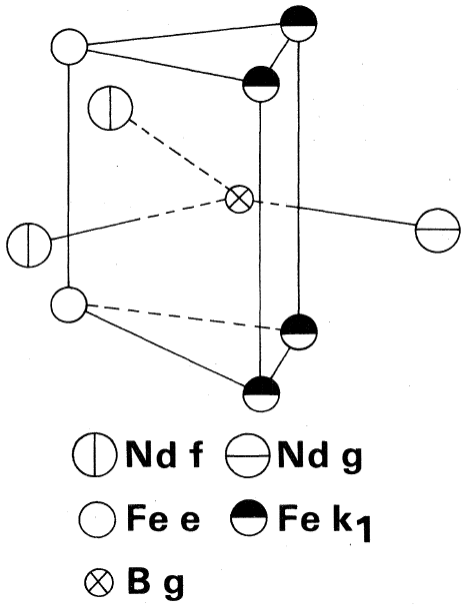
18 volte maggiore dei magneti in ferrite

Inventor Masato Sagawa

Struttura Cristallina

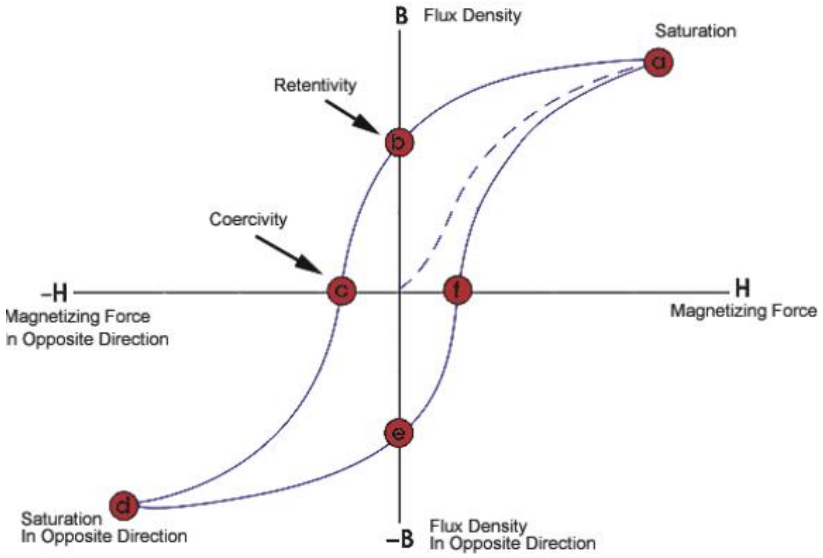




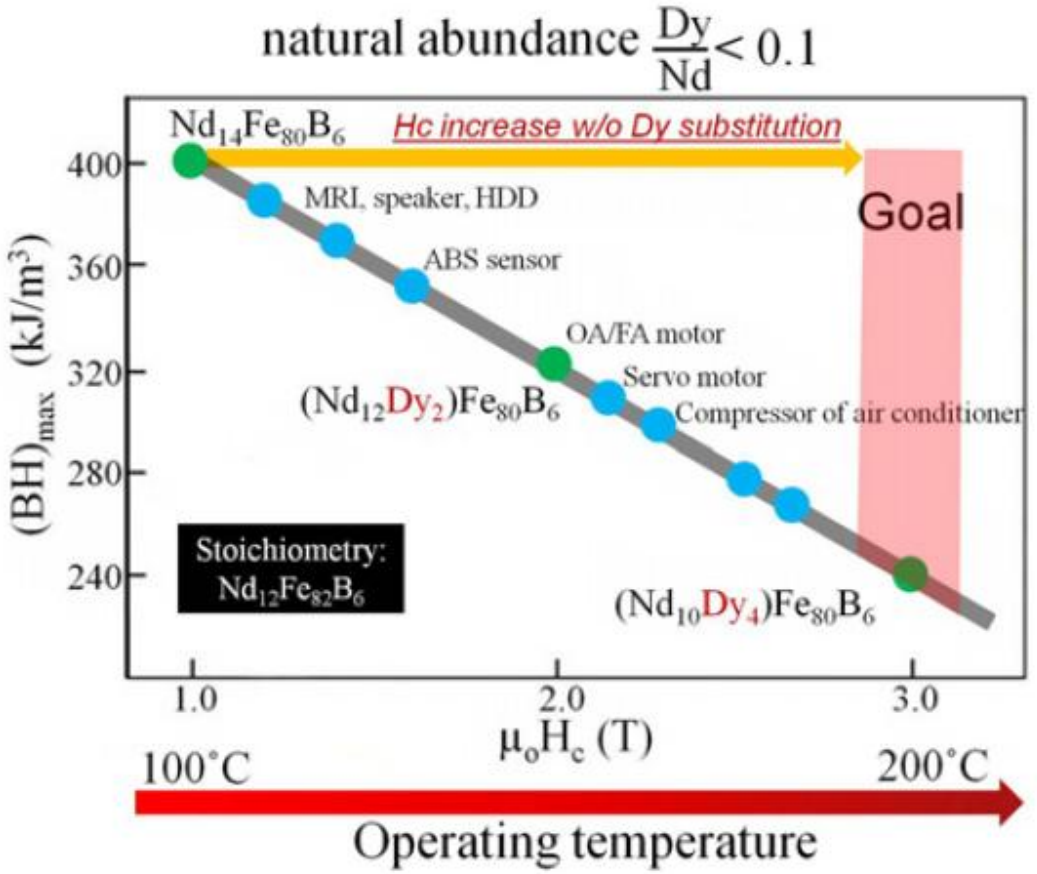


wikimedia

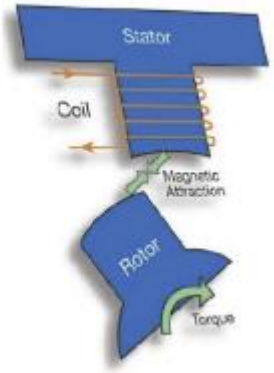
Magneti al Neodimio

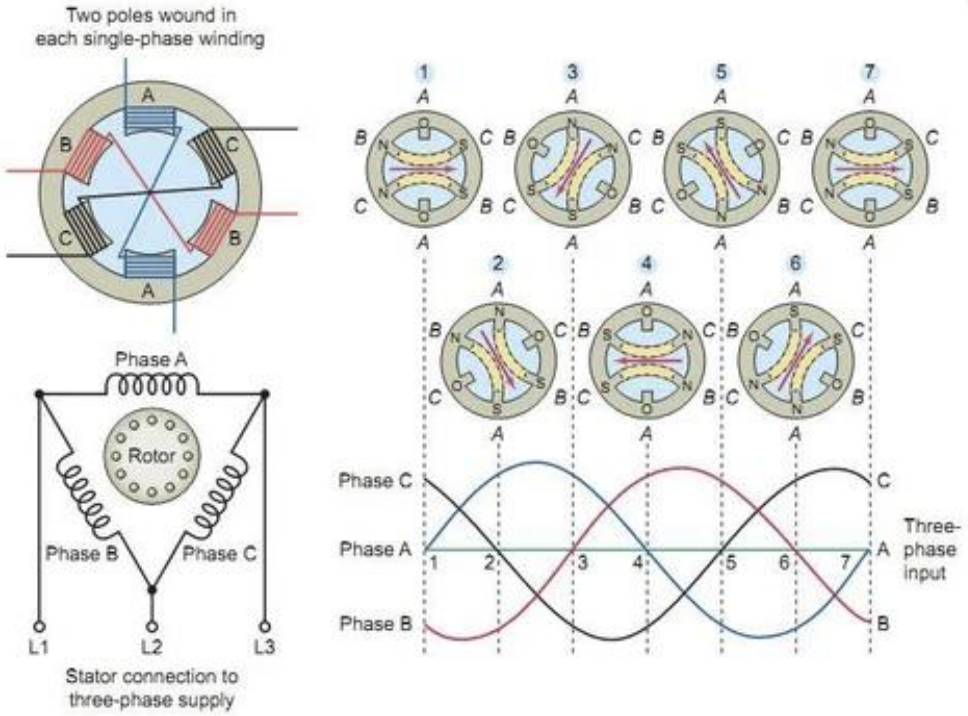


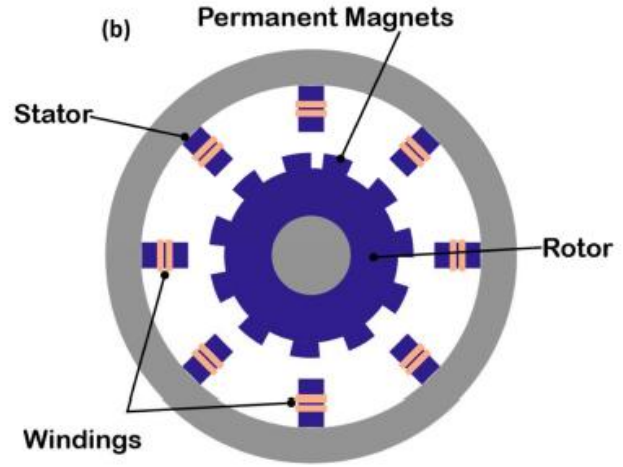
Stabilizzazione in temperatura con Dy

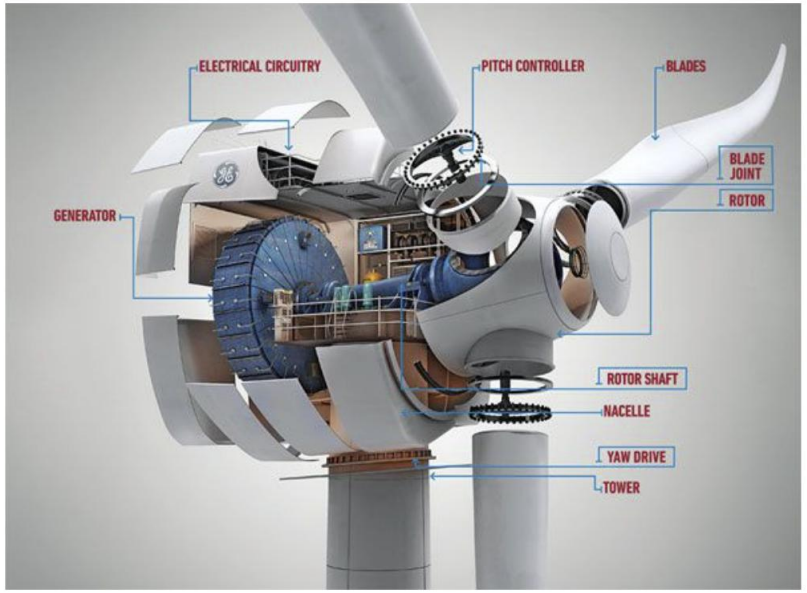


Motori e Generatori









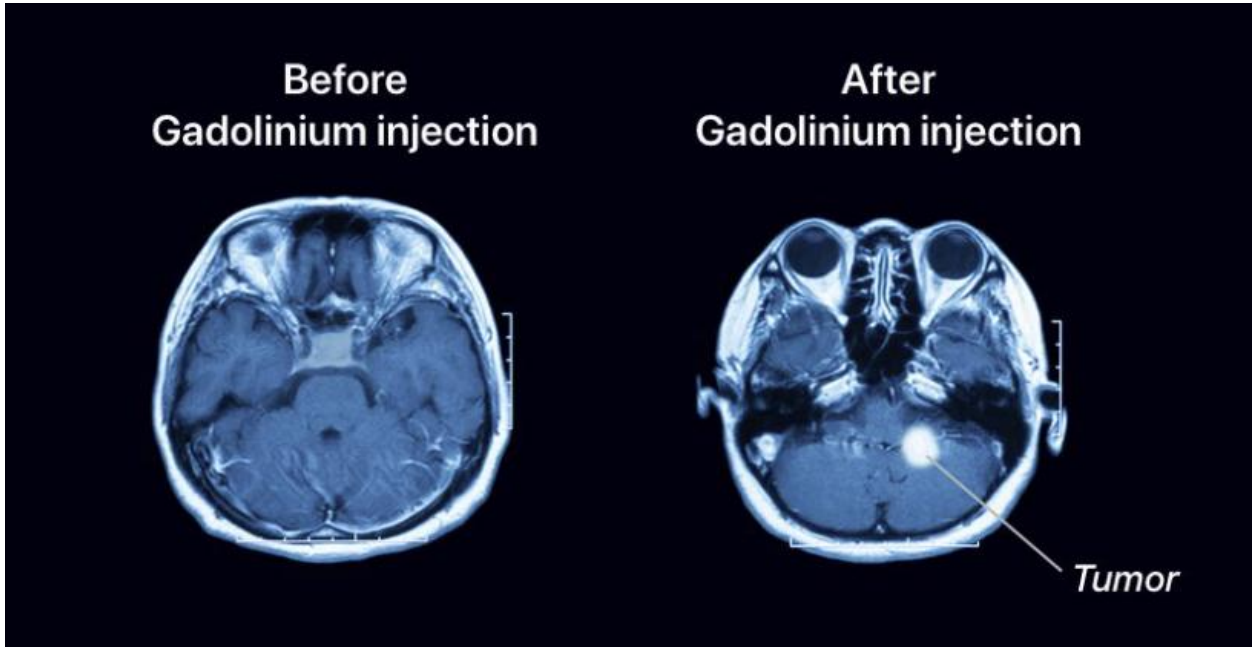
Medicina

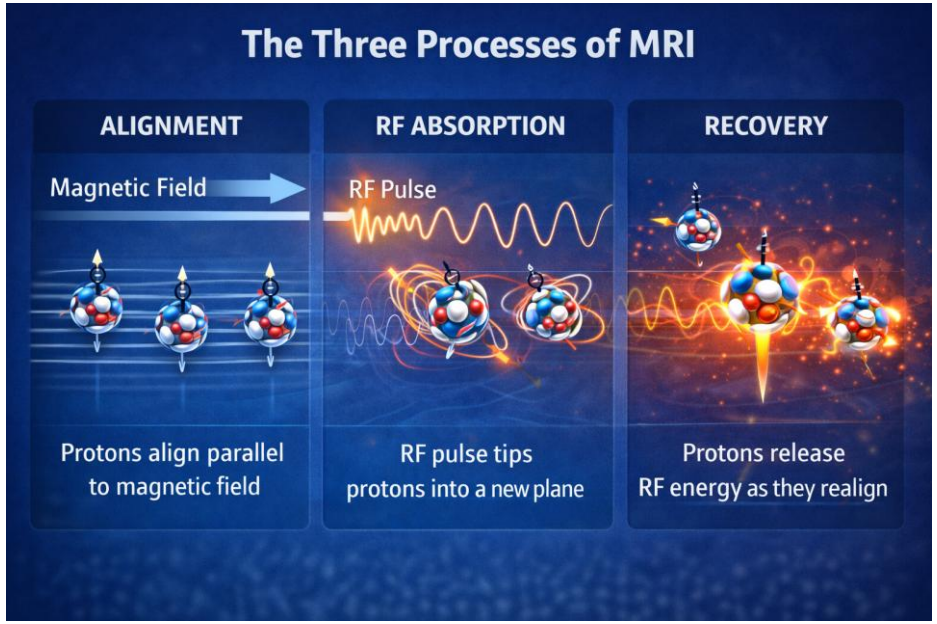
Caratteristica	Magneti Permanenti	Magneti Superconduttori
Intensità di campo	Solitamente tra 0.2 T e 0.5 T	Da 1.5 T a 7 T+
Costo operativo	Basso (nessun consumo di elio o molta corrente)	Elevato (elio liquido e manutenzione costante)
Peso	Molto elevato (tonnellate di materiale)	Più leggero (ma con strutture criogeniche)
Comfort	Alto (design aperto, ideale per claustrofobici)	Basso (tunnel stretto)

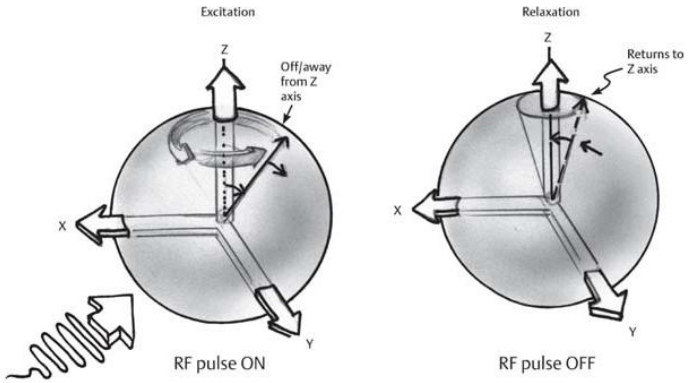
I magneti NdFeB permettono di costruire MRI con delle strutture innovative e a un minore costo di manutenzione. Il costo da pagare è una minore risoluzione spaziale (4-5 mm contro 1-3 mm)

- **Ortopedia di base**: Vedere una grossa rottura meniscale o un'ernia del disco evidente.
- **Pazienti claustrofobici**: Molti preferiscono un'immagine meno definita piuttosto che non fare affatto l'esame a causa del panico nel "tubo".
- **Costi**: L'esame costa meno sia alla struttura che (spesso) al paziente.

Medicina


Before
Gadolinium injection
After
Gadolinium injection
Tumor


The Three Processes of MRI
ALIGNMENT
RF ABSORPTION
RECOVERY
Magnetic Field
RF Pulse
Protons align parallel to magnetic field
RF pulse tips protons into a new plane
Protons release RF energy as they realign


Excitation
Z
Off/away from Z axis
X
Y
RF pulse ON
Relaxation
Z
Returns to Z axis
X
Y
RF pulse OFF

conclusioni

LCM
less common metals

Rare Earth Elements in a smartphone

Nd Neodymium

Pr Praseodymium

Dy Dysprosium

Gd Gadolinium

La Lanthanum

Eu Europium

Tb Terbium

It is not surprising that **92%*** of the UK population own a smartphone, but do you know what a smartphone is made up of?

Nd, **Pr**, **Gd**, **Tb** and **Dy** are used for the microphone, speakers and vibration.

La, **Pr**, **Eu**, **Gd**, **Tb**, and **Dy** are used in smartphone displays.

Small quantities of these **rare earth elements** are used for the colour and the glow.

*Data from Uswitch March 2021