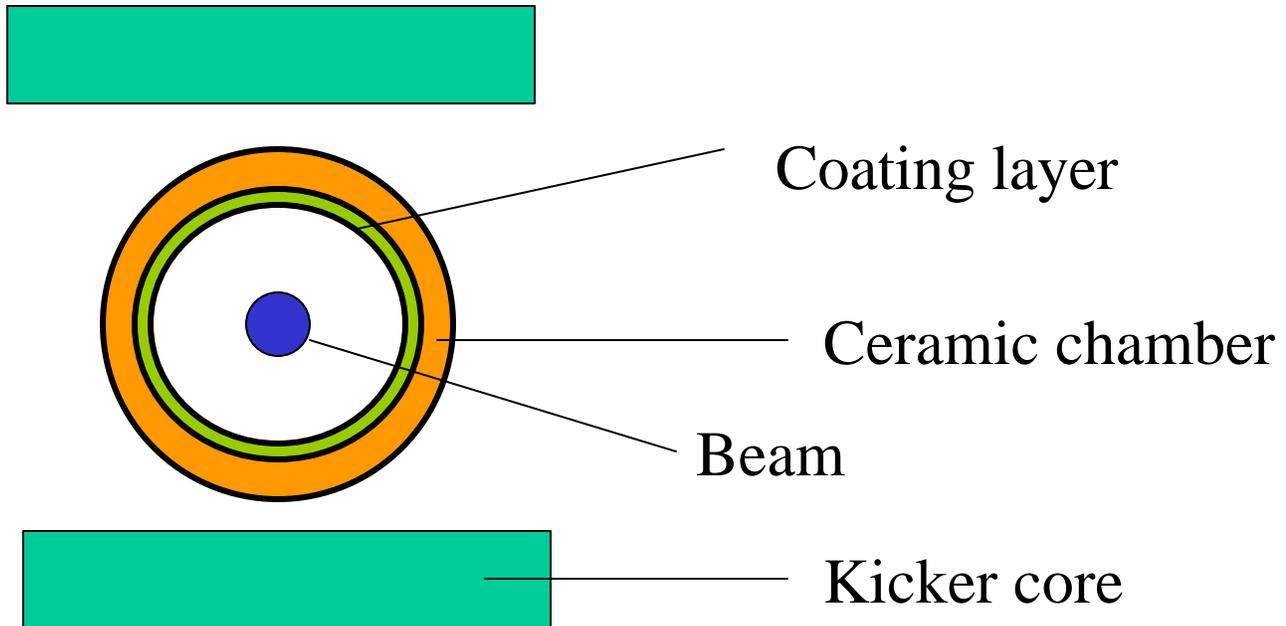


Ring injection chamber coating



Coating requirements:

- Unperturbed penetration of the kicker field (200 ns, .1T)
- Screening of the beam field (1MHz, 200kHz)
- Tolerable heat load
- Practical feasibility

Assumed parameters: chamber radius $r=10\text{cm}$, coating TiN
 $\mu=25$ *cm, ceramic chamber thickness $h_c=1\text{cm}$.

External field penetration

$$\text{Field Risetime: } t[\text{ms}] \approx .63 \frac{r[\text{cm}]\Delta[\text{mm}]}{r[\text{m}\Omega \cdot \text{cm}]}$$

$$\text{Required coating thickness: } \Delta[\text{mm}] < 1.6 \cdot \frac{t_B[\text{ms}]r[\text{m}\Omega \cdot \text{cm}]}{r[\text{cm}]}$$

$$\Delta_{TiN} < 1.6 \cdot \frac{200\text{ms} \cdot 25\text{m}\Omega \cdot \text{cm}}{10\text{cm}} = 800\text{mm}$$

Beam field screening

$$\Delta[\text{mm}] > .25 \cdot \frac{r[\text{m}\Omega \cdot \text{cm}]}{h_c[\text{cm}] \cdot f_B \text{MHz}} = .25 \frac{25[\text{m}\Omega \cdot \text{cm}]}{1\text{cm} \cdot 1\text{MHz}} \approx 6.3\text{mm}$$

$$\text{For the sideband of 200kHz: } \Delta < 30\text{mm}$$

Heat from Eddy current

$$\begin{aligned} P/l \left[\frac{W}{m} \right] &= \frac{2p f_0 B^2 r^3 \Delta}{rt} \approx \\ &\approx \frac{6.28 \cdot 60 \text{ Hz} \cdot 10^{-2} T^2 \cdot 10^{-3} m^3 \cdot 25 \text{ mm}}{25 [\text{m}\Omega \cdot \text{cm}] \cdot 10^{-2} \cdot 2 \cdot 10^{-4}} \approx \\ &\approx 1900 \frac{W}{m} \quad \Rightarrow \quad .3 \frac{W}{\text{cm}^2} \end{aligned}$$

Heat from beam current

$$\begin{aligned} P/l \left[\frac{W}{m} \right] &= \frac{I_B^2 r f_0 t_B}{2pr\Delta} \approx \\ &\approx \frac{30^2 A^2 \cdot 60 \text{ Hz} \cdot 10^{-3} s \cdot 25 \text{ m}\Omega \cdot \text{cm}}{6.28 \cdot 10 \text{ cm} \cdot 25 \text{ mm}} \approx 70 \frac{\text{mW}}{m} \end{aligned}$$

Conclusion

25 μ m layer of TiN satisfies the requirements of kicker field penetration, beam field screening and induced heat load.

Open questions

Is assumed 25 μ m realistic and stable value?

Is 200kHz sideband suppression necessary ?

Other?