Problem 8.46 Measurement of the TE_{101} frequency response of an air-filled cubic cavity revealed that its Q is 4802. If its volume is 64 mm^3, what material are its sides made of? [Hint: See Appendix B.]

Solution:

According to Eq. (8.121), the TE_{101} resonant frequency of a cubic cavity is given by

$$f_{101} = \frac{3\times 10^8}{\sqrt{2}\,a} = \frac{3\times 10^8}{\sqrt{2}\times 4\times 10^{-3}} = 53.0 \text{ GHz}.$$

Its Q is given by

$$Q = \frac{a}{3\delta_s} = 4802,$$

which gives $\delta_s = 2.78\times 10^{-7}$ m. Applying

$$\delta_s = \frac{1}{\sqrt{\pi f_{101}\mu_0\sigma_c}},$$

and solving for σ_c leads to

$$\sigma_c \simeq 6.2\times 10^7 \text{ S/m}.$$

According to Appendix B, the material is silver.