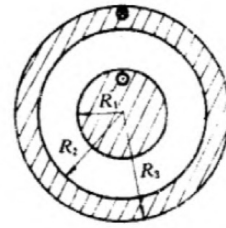


3-34 一同轴电缆内导体半径为 R_1 ，外导体内、外半径分别为 R_2, R_3 。导体材料为铜。电缆中沿轴向通过电流 I 。见图题3-34。试用泊松方程求空间各点的矢量磁位 A （以电缆轴线处为参考点）。



图题3-34

各点 \vec{A} 的表达式应为 $\vec{A} = A_z(r) \cdot \vec{k} = \vec{A}_z$

边值问题为：

$$\nabla^2 \vec{A}_z = \frac{1}{r} \cdot \frac{\partial}{\partial r} \left(r \cdot \frac{\partial A_z}{\partial r} \right) = \mu_1 \cdot \frac{I}{\pi R_1^2}$$

$$\nabla^2 \vec{A}_z = \frac{1}{r} \cdot \frac{\partial}{\partial r} \left(r \cdot \frac{\partial A_z}{\partial r} \right) = 0$$

$$\nabla^2 \vec{A}_z = \frac{1}{r} \cdot \frac{\partial}{\partial r} \left(r \cdot \frac{\partial A_z}{\partial r} \right) = \mu_2 \cdot \frac{I}{\pi (R_3^2 - R_2^2)}$$

$$\nabla^2 \vec{A}_z = \frac{1}{r} \cdot \frac{\partial}{\partial r} \left(r \cdot \frac{\partial A_z}{\partial r} \right) = 0$$

$$A_z(R_1) = A_z(R_2) = 0$$

$$A_z(R_2) = A_z(R_3)$$

$$A_z(R_3) = A_z(R_4)$$

$$\frac{1}{\mu_1} \frac{\partial}{\partial r} A_z(r) \Big|_{r=R_1} = \frac{\partial}{\partial r} A_z(r) \Big|_{r=R_1} \cdot \frac{1}{\mu_2}$$

$$\frac{1}{\mu_2} \frac{\partial A_z(r)}{\partial r} \Big|_{r=R_2} = \frac{1}{\mu_3} \frac{\partial A_z(r)}{\partial r} \Big|_{r=R_2}$$

$$\frac{1}{\mu_3} \frac{\partial A_z(r)}{\partial r} \Big|_{r=R_3} = \frac{1}{\mu_4} \frac{\partial A_z(r)}{\partial r} \Big|_{r=R_3}$$

通解为：

$$\vec{A}_z = \left(\frac{\mu_1 I}{4\pi R_1^2} \cdot r^2 + C_{11} \ln r + C_{12} \right) \cdot \vec{k}$$

$$\vec{A}_z = (C_{21} \ln r + C_{22}) \cdot \vec{k}$$

$$\vec{A}_z = \left(-\frac{\mu_2 I}{4\pi (R_3^2 - R_2^2)} + C_{31} \ln r + C_{32} \right) \cdot \vec{k}$$

$$\vec{A}_z = (C_{41} \ln r + C_{42}) \cdot \vec{k}$$