The synthesis of **malachite green** involves the condensation of **benzaldehyde** with **dimethylaniline** in the presence of an acid catalyst. This process is a Friedel-Crafts alkylation reaction.

Reaction Steps:

1. **Starting Materials:**
   - Benzaldehyde (C_6H_5CHO)
   - Dimethylaniline ($C_6H_5N(CH_3)_2$)
   - Acid catalyst (e.g., sulfuric acid or hydrochloric acid)
2. **Mechanism:**
   - The carbonyl group of benzaldehyde undergoes protonation by the acid catalyst, making the carbonyl carbon more electrophilic.
   - Dimethylaniline, acting as a nucleophile, attacks the electrophilic carbonyl carbon of benzaldehyde.
   - This results in the formation of a condensation product.
3. **Formation of the Dye:**
   - Through further reaction steps involving oxidation and coupling, the malachite green dye is formed.
   - The product has a triarylmethane structure, which is responsible for its characteristic green color.

Overall Reaction:

$$C_6H_5CHO + 2C_6H_5N(CH_3)_2 \xrightarrow{H^+} \text{Malachite Green Dye}$$

Final Structure of Malachite Green:

The structure of malachite green includes a central carbon atom bonded to three aromatic rings, with one of the aromatic rings substituted with two methyl groups attached to the nitrogen atom. The dye is cationic, with a counterion (e.g., chloride) to balance the charge.

This method demonstrates the application of aromatic chemistry and electrophilic aromatic substitution in the synthesis of dyes.