IR SPECTROSCOPIC ANALYSIS OF FABRICS DYED WITH 3D METAL COMPLEXES SYNTHESIZED FROM COTTON FIBER

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Abstract: *Cotton fiber is mainly composed of cellulose, and its hydroxyl groups allow for the formation of complexes with various metal ions. Metal-complex dyes increase the color stability, abrasion resistance, and functional properties of fabrics. IR spectroscopy (4000-400 cm^{-1}) is an effective method for determining the influence of functional groups and metal ions on the fabric. Complexation of fabric obtained on the basis of cotton fiber based on Cu^{2+}, Ni^{2+}, Co^{2+} and Fe^{3+} ions, analysis of IR spectroscopy after dyeing with epichlorohydrin, triethanolamine and acetic acid, and determination of functional groups.*

Ключевые слова: *хлопчатобумажная ткань, аминирование, эпихлоргидрин, триэтаноламин, металлокомплексы, термогравиметрический анализ, дифференциально-термический анализ.*

In the study, fabric based on cotton fiber was used as the main material. 3d metal ions are selected as metal ions. When dyeing the fabric, epichloridrin, triethanolamine, and acetic acid were used, which ensured the formation of metal complexes and the process of adsorption on the fiber. Infrasound-width (IW) spectroscopic analysis was carried out in the range of 4000-400 cm^{-1} using the tablet method of KBr. Using this method, the functional groups and structural changes of fabrics modified with metal complexes were determined.

The results obtained using infrasonic-width (IR) spectroscopy made it possible to determine the influence of functional groups, metal complexes, and

dyes on fabrics based on cotton fiber. The analysis was carried out in two main directions: the main IR signals and metal complexes for cotton fiber, as well as the spectral effect of dyeing agents.

1. Basic IR signals for cotton fiber

Range, cm^{-1}	**Functional group**	**Explanation**
3300–3400	–OH	Peak widened by hydrogen bonds
2900–2930	–CH	Aliphatic lactic acids
1640–1650	C=O (H_2O effect)	Signal associated with water molecules on fabric
1050–1150	C–O–C va C–O	Glycosidic bonds

Spectral analysis showed that the main functional groups of cotton fiber fibers are -OH, -CH and C-O-C, C-O, which regulate the main changes in the process of adsorption of metal complexes on the fiber.

2. Effects of metal complexes. Metal ions significantly altered the spectral properties:

- The Cu^{2+}: -OH peak softens, and a C-O-Cu bond peak can also form around 1100 cm−1.
- Ni^{2+} and Co^{2+} attenuate the -OH signal, and a metal-oxide bond peak is detected in the range of 500-600 cm^{-1}.
- Fe^{3+}: reduces the -OH signal, a Fe-O bond peak is observed in the range of 600-650 cm^{-1}.

These changes are explained by the fact that 3d metal ions penetrate the fiber, changing the hydrogen bonding system and forming new metal-oxide bonds.

3. Spectral effect of dyes. Epichloridrin: forms a C-O-C epoxy peak in the range of 910-950 cm^{-1} and reduces the -OH signal, which indicates its modification by epoxy groups introduced into the fiber.

Triethanolamine: forms N-H and -OH peaks in the range of 3200-3400 cm^{-1}, a N-C-O bond peak is detected in the range of 1040-1100 cm^{-1}. This means that triethanolamine introduces new amino and hydroxyl groups into the fiber.

Acetic acid: COO-peak is detected in the range of 1720-1740 cm^{-1}, which indicates the addition of acidic functional groups to the fabric.

Conclusion. The obtained results show that metal complexes and dyes significantly influence the structure of cotton fiber. Spectral changes are determined by -OH, C-O-C, C=O and metal-oxide bond signals. This allows us to understand the formation of new functional groups in the fiber and the mechanism of adsorption of metal ions on the fiber.

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