A dope-dyed core-sheath type composite fiber contains a core layer (A) and a sheath layer (B) which entirely covering the core layer (A). The core layer (A) contains at least one or a plurality of dye materials with at least 0.1% wt in the core part, composites of the core layer (A) and the sheath layer (B) are both dye-soluble polymers. The fineness of the core-sheath type composite fiber is more than 0.5 Denier-per-filament, and a cross-sectional area ratio of the sheath layer X(B) and X(B) 20%.
DOPE-DYED CORE-SHEATH TYPE COMPOSITE FIBER

FIELD OF THE INVENTION

[0001] The present invention relates to a composite fiber (conjugate fiber), and more particularly to a core/sheath type composite fiber which includes a sheath layer and a core layer, and composites of the core layer have certain concentration of dyes so as to obtain target color with excellent color fastness.

BACKGROUND OF THE INVENTION

[0002] Solution dyeing (dope dyeing) has been applied on dye-soluble polymer fiber (such as polyester fiber and nylon fiber) for many years, since the solution dyeing will not produce waste water like bath dyeing, it is environmental friendly to proceed solution dyeing. Nevertheless, the solution dyeing used for dye-soluble polymers includes pigment and the dye material (such as solvent dye and disperse dye). When only the pigment is served as the dyeing material of the solution dye, normally the dope dyed fiber has excellent color fastness. Unfortunately there are many color hues which could not be matched only by pigment. To reach such bright hues, the dye material is required, but dye material in dye-soluble polymer normally cannot add more than 0.1 wt% in the fiber so as to avoid migration problem, thereby limiting the application of solution dyeing seriously.

[0003] U.S. Pat. No. 5,888,651 taught that colored bicomponent fibers contains one solution dyeing component and the other component without solution dyeing, but the colorant is pigments instead of dye material.

[0004] CN Pat. No. 101611180 disclosed that a fade-resistant sheath-core bicomponent fibers contains a core layer and a sheath layer, and the core layer has dye material in the dye-soluble core polymer, and the sheath layer does not have dye material but has dye-insoluble sheath polymer. However, when the polymers of the core layer and the sheath layer are chosen from dye-soluble polymer and dye-insoluble polymer respectively, compatibility of the dye-soluble polymer and the dye-insoluble polymer is poor and cause much lower fiber strength, thus limiting the application range.

[0005] CN Pat. No. 102131968 taught that both the core layer and the sheath layer have solution dyeing applied respectively, and a color of a sheath layer has more brightly color than that of the core layer. But the dye color is normally more brightly than pigment color and under such technology the dye material has to be designed in the sheath layer, so it is helpless for color fastness. In addition, the solution dyeing has to be proceeded both in the core layer and the sheath layer to obtain such color effect.

[0006] Accordingly, the dye material is necessary for dope dyed fiber and the target is to achieve higher color fastness.

[0007] The present invention has arisen to mitigate and/or obviate the aforesaid disadvantages.

SUMMARY OF THE INVENTION

[0008] Dye-soluble polymer fiber, such as polyesters and polyamides could be dope dyed by single component, and the dyes and the pigments are chosen to be used as dope dyeing recipe. When using dyes material, especially when the molecular weight of the dye is less than 400 g/mol, the dyes are migrating easily, and in case total content of the dyes is more than 0.1 wt%, it is also risky to pollute the spinning-guide in spinning process, thus increasing the production cost.

[0009] Thereby, a dope-dyed core/sheath type composite fiber provided by the present invention which has more than 0.5 Denier-per-filament (dpf), a core layer (A) and a sheath layer (B) which entirely covering the core layer (A); characterized in that the core layer (A) contains at least one or a plurality of dye materials with at least 0.1% wt in the core part, composites of the core layer (A) and the sheath layer (B) are both dye-soluble polymers.

[0010] When the composites of the core layer and the sheath layer are both dye-soluble polymers, compatibility of the core layer (A) and the sheath layer (B) is better and the conjugate fibers have higher fiber strength to be applicable for various specifications. After combination of core layer and sheath layer in the spinning box and before completely cooling during extension process, the composites of the core layer (A) and the sheath layer (B) are still in high temperature with melting state, and a part of dye material of the core layer moves to the sheath layer. Since this moving time is so short, when the composites move out of the cooling outlet, the transferring process stops. If the sheath layer has certain thickness, the dye material could not reach the outer surface of the sheath layer. After taking up and cross section of the fiber is cut, we could observe by microscope the dye material of the core layer is partially transferred, and the boundary of the core layer and the sheath layer produces blurred image. However, when only the pigments is employed in the core layer, interface of the boundary of the core layer and the sheath layer is clear and produces a clear line. To provide enough thickness of the sheath layer (B) for covering all the dye material in the core layer (A), the dope-dyed core/sheath type composite fiber of the present invention has a fineness more than 0.5 Denier-per-filament (dpf), and a cross-sectional area ratio $X(B)$, the cross-section area ratio of sheath layer B in the core/sheath type composite fiber, is more than 20%, i.e., $X(B)\geq 20\%$.

[0011] The sheath layer (B) covers the core layer (A) completely, and the cross section of the sheath layer (B) and the core layer (A) could be concentric or eccentric, and cross section of the core layer (A) is circular, polygonal or is in an orange peel shape. In addition, the cross section of the core layer (A) could be in multi-island shape with at least two areas.

[0012] The composites of the core layer (A) and the sheath layer (B) are both dye-soluble polymers, such as polyester polymer (including polyethylene terephthalate), polyester copolymer, polyamide polymer (including nylon 6 and nylon6,6), or polyamide copolymer.

[0013] If the core layer (A) is polyester polymer, its solution dye could be selected from solvent dye or dispersible dye, such as CI color index number: Solvent Yellow 163, Solvent Yellow 133, Solvent Red 52, Solvent Red 135, Solvent Red 195, Solvent Red 212, Solvent Violet 49, Disperse Violet 27, Disperse Violet 57, Solvent Blue 45, Solvent Blue 104, Solvent Blue 122, Disperse Blue 73, Solvent Green 3, Solvent Green 28, Solvent Brown 53, and Solvent Orange 63, etc. The solution dye of the core layer (A) can also match with at least one pigment so as to match the target color or to reduce coloring cost. Meanwhile, the sheath layer (B) of the conjugate fiber is preferred to use also polyester polymer so as to achieve excellent compatibility, thus having higher yarn strength and also better spinnability during spinning.

[0014] The present invention has arisen to mitigate and/or obviate the aforesaid disadvantages.
[0014] When the core layer (A) is polyamide polymer, its solution dye could be solvent dye, such as CI color index number: Solvent Yellow 21, Solvent Orange 60, Solvent Orange 63, Solvent Red 52, Solvent Red 135, Solvent Red 225, and Solvent Blue 132, etc. The solution dye of the core layer (A) can also match with at least one pigment so as to match the target color or to reduce coloring cost. Meanwhile, the sheath layer (B) of the conjugate fiber is preferred to use also polyamide polymer so as to achieve excellent compatibility, thus having higher yarn strength and also better spinning capability during spinning.

[0015] When the core layer (A) and sheath layer (B) are selected from polyester polymer or polyamide polymer, pigment or very small amount of dye material can be added into the sheath layer (B) based on requirements, due to the dye material is within much lower content, the migration problem will not happen. Nevertheless, the safety content without migration problem of different dye materials is all different and has to be checked individually.

[0016] The primary object of the present invention is to provide a dope-dyed core-sheath type composite fiber in which dye material is used and has better color fastness without migration problem.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. 1 is a cross sectional view showing the assembly of a dope-dyed core-sheath type composite fiber according to the present invention.

DETAILLED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] A dope-dyed core-sheath type composite fiber according to a first embodiment of the present invention is a Spin Draw Yarn (SDY) of polyester conjugate multi-filament yarn with 1.04 Denier-per-filament. Composite of the core layer A is semi-dull polyester polymer which contains 0.3 wt % of titanium dioxide, and the core layer A is dope dyed with Solvent Blue 122 through a masterbatch meter so as to form 2.0% wt % content in the core part. Composite of the sheath layer B is semi-dull polyester polymer which contains 0.3 wt % of titanium dioxide, the sheath layer B is not dope dyed, a cross-sectional area ratio of the sheath layer B and the core layer A is 50/50, i.e., X(B)=50%, spinning speed is 4500 m/min, and the extension ratio is 3.2 times.

[0019] Comparative Example 1 is a Spin Draw Yarn (SDY) mono component polyester multi-filament yarn with 1.04 Denier-per-filament. The composite is semi-dull polyester polymer which contains 0.3 wt % of titanium dioxide and is dope dyed with Solvent Blue 122 through a masterbatch meter so as to form 1.0 wt % content in the fiber, wherein spinning speed is 4500 m/min, and the extension ratio is 3.2 times.

[0020] Comparative Example 1 and Embodiment 1 have identical dye content, i.e., 1.0% of Solvent Blue 122.

[0021] Determining progression of various stained multi fabric of stained gray scale color fastness is listed below, wherein the Embodiment 1 and the Comparative Example 1 are tested under ISO 105 C04 (95° C.) of washing test condition and are woven from knitted material:

<table>
<thead>
<tr>
<th></th>
<th>Stained</th>
<th>Wool</th>
<th>Acrylic</th>
<th>PET</th>
<th>Nylon</th>
<th>Cotton</th>
<th>Acetic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embodiment 1</td>
<td>4-5</td>
<td>4-5</td>
<td>4-5</td>
<td>4</td>
<td>4-5</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Comparative Example 1</td>
<td>3-4</td>
<td>4-5</td>
<td>3-4</td>
<td>2-3</td>
<td>4</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

[0022] Comparative Example 2 is a core sheath type of Spin Draw Yarn (SDY) of polyamide conjugate multi-filament yarn with 2.92 Denier-per-filament. The composite of core layer A is bright type nylon 6 which does not contain titanium dioxide and is dope dyed with Solvent Red 225 through a masterbatch meter so as to form 1.25 wt % content in the core part. Composite of the sheath layer B is bright type nylon 6 which does not contain titanium dioxide, the sheath layer B is not dope dyed, a cross-sectional area ratio of the sheath layer B and the core layer A is 40/60, i.e., X(B)=40%, spinning speed is 4300 m/min, and the extension ratio is 2.5 times.

[0023] Comparative Example 2 is a Spin Draw Yarn (SDY) mono component polyamide multi-filament yarn with 2.92 Denier-per-filament. The composite is bright type nylon 6 which does not contain titanium dioxide and is dope dyed with Solvent Red 225 through a masterbatch meter so as to form 0.75 wt % content in the fiber, wherein spinning speed is 4300 m/min, and the extension ratio is 2.5 times.

[0024] Comparative Example 2 and Embodiment 2 have identical dye content, i.e., 0.75% of Solvent Red 225.

[0025] Determining progression of various stained multi fabric of stained gray scale color fastness is listed below, wherein the Embodiment 2 and the Comparative Example 2 are tested under ISO 105 C04 (95° C.) of washing test condition and are woven from knitted material:

<table>
<thead>
<tr>
<th></th>
<th>Stained</th>
<th>Wool</th>
<th>Acrylic</th>
<th>PET</th>
<th>Nylon</th>
<th>Cotton</th>
<th>Acetic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embodiment 2</td>
<td>4-5</td>
<td>4-5</td>
<td>4-5</td>
<td>4</td>
<td>4-5</td>
<td>4-5</td>
<td></td>
</tr>
<tr>
<td>Comparative Example 2</td>
<td>3-4</td>
<td>4-5</td>
<td>3-4</td>
<td>2</td>
<td>4-5</td>
<td>2-3</td>
<td></td>
</tr>
</tbody>
</table>

[0026] While the preferred embodiments of the invention have been set forth for the purpose of disclosure, modifications of the disclosed embodiments of the invention as well as other embodiments thereof may occur to those skilled in the art. Accordingly, the appended claims are intended to cover all embodiments which do not depart from the spirit and scope of the invention.

What is claimed is:

1. A dope-dyed core-sheath type composite fiber comprising:
   a core layer (A) and a sheath layer (B) entirely covering the core layer (A); characterized in that:
   the core layer (A) contains at least one or a plurality of dye materials with at least 0.1% wt in core part, composites of the core layer (A) and the sheath layer (B) are both dye-soluble polymers;
   A fineness of the core-sheath type composite fiber is more than 0.5 Denier-per-filament, and a cross-sectional area ratio of the sheath layer X(B) and X(B)<20%.

2. The dope-dyed core-sheath type composite fiber as claimed in claim 1, wherein composite of the core layer (A) is polyester polymer, and composite of the sheath layer (B) is polyester polymer.
3. The dope-dyed core-sheath type composite fiber as claimed in claim 1, wherein composite of the core layer (A) is polyamide polymer, and composite of the sheath layer (B) is polyamide polymer.