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FLUOROCARBON TUNGSTEN MEMBERS

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This invention relates to new and useful improvements in radiopaque fluorocarbon tubing and more particularly seeks to provide a cardiac catheter composed primarily of fluorocarbon and tungsten.

The unusual properties of the fluorocarbons, particularly polytetrafluoroethylene, are ideal for forming extruded tubing such as cardiac or other catheters because of the following properties, among others. First, within the temperature range of 70-110° F., there is no appreciable change in degree of stiffness. Second, the curved distal tips are heat set at over 600° F. and do not flatten out at body temperature, thus making introduction easier. Third, the lowest coefficient of friction of any known materials makes them less traumatic and easier to introduce. Fourth, their non-wettable surfaces reduce the tendency of the catheter to coagulate blood. Fifth, their zero absorption of water as liquid or vapor causes catheters to retain their length and hardness longer than most other materials. Sixth, they are unaffected by temperature up to 600° F. and thus may be repeatedly boiled or autoclaved with no harmful effect. The autoclaving causes no softening and need not be followed by drying because no moisture can be absorbed as already pointed out. Seventh, nothing sticks to fluorocarbons, not even strong adhesives, and thus they are easy to clean and have much less tendency to collect deposits of any kind. Eighth, the lumen is extremely smooth and friction-free so as to be ideal for injections where the lowest possible resistance to flow is necessary. Ninth, the materials are non-toxic, inert and have a lower order of tissue reactivity.

It is essential in most instances for cardiac catheters to be radiopaque in order to follow the path of introduction on the fluoroscope. Accordingly, conventional radiopaque metals such as tin, lead and bismuth have been added to the fluorocarbons. However, the powdered polytetrafluoroethylene is extruded at room temperature but then sintered at 650-800° F., generally 750°, whereupon these metals are discolored and thereafter deteriorate relatively rapidly so that the catheters tend to split, crack, etc., under pressure and mechanical distortion. Furthermore, these metals are medically toxic.

It is, therefore, an object of this invention to provide a radiopaque fluorocarbon tube which will not discolor during sintering, nor deteriorate thereafter and which will contain no medically toxic materials.

I have found that these objects may be attained by incorporating tungsten within the fluorocarbon composition of cardiac catheters or other radiopaque members.

With the above objects and features in view, the nature of which will be more apparent, the invention will be more fully understood by reference to the accompanying detailed description and the appended claims.

To 80 parts by weight of polytetrafluoroethylene powder is intimately mixed 20 parts of tungsten powder and sufficient mineral spirits solvent to make a paste for extrusion. This is then extruded at room temperature into the desired cardiac catheter shape and subsequently sintered at about 750° F. to produce a non-toxic catheter

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having excellent flex-resistance with no deterioration or discoloration.

It is obvious that in addition to cardiac catheters, any tubular, rod or other shape extrusion where radiopacity is desired may be formed. Extrusion may be from a melted liquid (FEP) or the extrusion and sintering may be a simultaneous operation starting with a dry mixture of materials if sufficient pressure and proper temperature is used. The sintering temperature will be that normal for polytetrafluoroethylene which presently ranges from 650-800° F. The invention is applicable to any of the fluorocarbons, e.g. polytetrafluoroethylene (TFE), fluorinated ethylene propylene (FEP), (both sold under Du Pont's registered trademark, Teflon), polytrifluorochloroethylene (sold under Minnesota Mining and Manufacturing Company's trademark, EL-F), and other chlorinated fluorocarbons.

Since tungsten is very dense (specific gravity of 19.3), its relative volume in the composition will be much less than its relative weight. The range of tungsten by weight is preferably from 5 to 30% of the total composition. Amounts outside this range are usable but the radiopacity is relatively weak below 5% and the mechanical properties of the fluorocarbon is weakened above 30%.

I claim:

1. A radiopaque material comprising a solid fluorocarbon polymer and sufficient tungsten intimately mixed therewith to render said material radiopaque.

2. A radiopaque extruded member comprising a solid fluorocarbon polymer and sufficient tungsten intimately mixed therewith to render said material radiopaque.

3. A radiopaque extruded and sintered tube member formed from a fluorocarbon polymer powder and 5 to 30% by weight of tungsten powder intimately mixed therewith.

4. The member of claim 3 wherein said tube is a cardiac catheter.

5. The member of claim 4 wherein said fluorocarbon is polytetrafluoroethylene.

6. The member of claim 4 having about 20% of said tungsten.

7. A method for forming a radiopaque tube comprising intimately mixing fluorocarbon polymer powder and sufficient tungsten powder to render said tube radiopaque, extruding said mixed powder as said tube, and sintering said extruded tube at about 650-800° F.

8. The method of claim 7 wherein said tungsten comprises 5 to 30% by weight of the total powder content.

9. The method of claim 8 wherein said fluorocarbon is polytetrafluoroethylene.

10. The method of claim 9 wherein said tungsten is about 20%.

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