

New generation of recyclable and rigid heat-shrinkable tubes

Heat-shrinkable tubes (HSTs) can shrink back to original sizes when they are heated to shrinkage temperatures (T_s), and they have been widely used in automobiles, electronics, communications, aircrafts, petroleum, aerospace and so on. Traditional HSTs are made of crystalline polymers and can be used only once in most cases. Here we have prepared recyclable HSTs, which are made of amorphous polyimides and their heat-shrinkage is caused by glass transition rather than melting of crystallites in traditional HSTs. The polyimide heat-shrinkable tubes (PIHST) with different T_s s from about 180 to 330 °C can extend the application areas of HSTs, as high temperature HSTs are still lacking. Compared with the low temperature limits of -40 to -80 °C for traditional HSTs, PIHSTs can withstand low temperature of -196 °C and thus widen the operating temperature ranges of HSTs greatly. PIHSTs can fix expanded diameters and shrink back to original diameters very well, and their heat-shrinkage process is manifested in Figure 1.

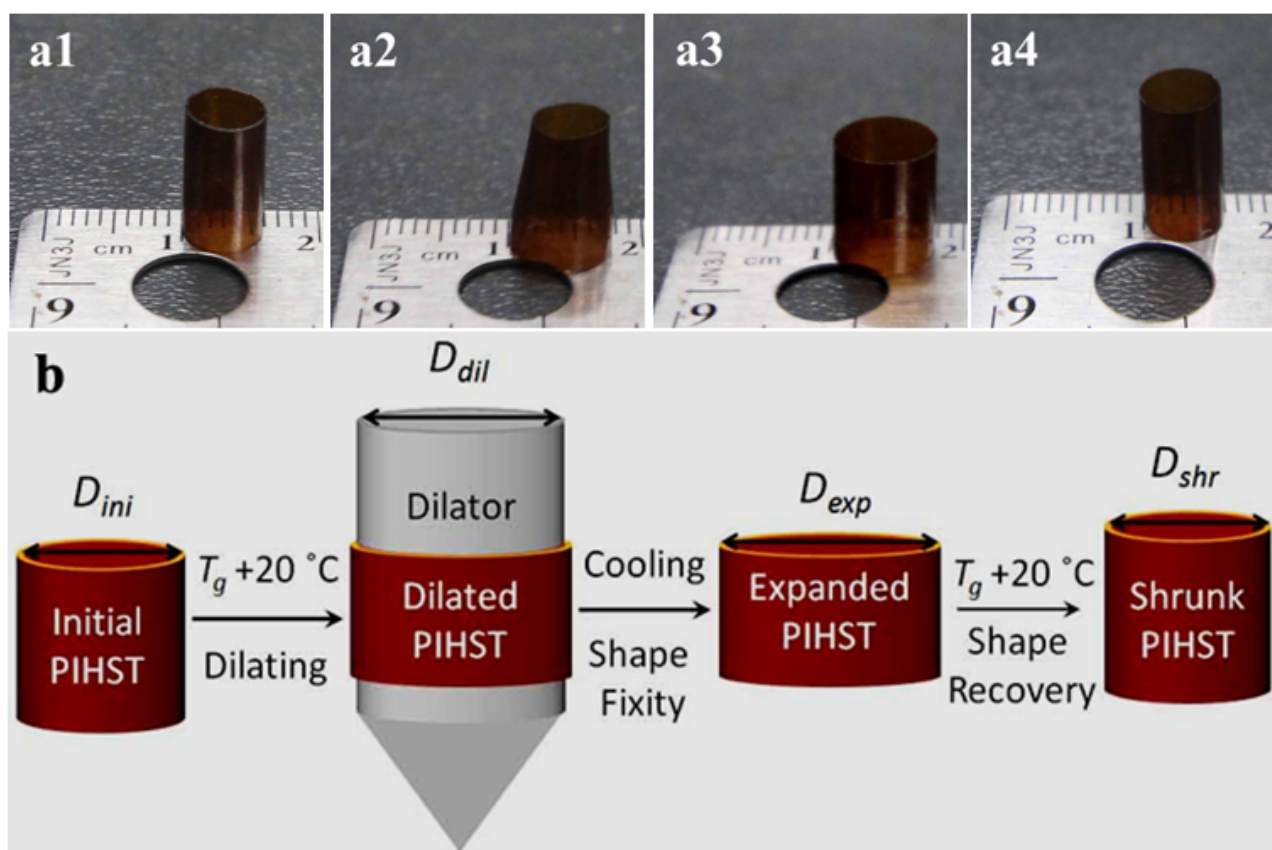


Fig. 1. Practical process (a) and schematic model (b) of heat-shrinkage process of PIHST. (a1) Its initial, (a2) partially expanded, (a3) fully expanded, and (a4) shrunk state.

Traditional high temperature HSTs are unable to hold or fix heavy load since they are flexible or

semi-rigid, while the rigid PIHSTs can embrace and connect subjects of different sizes by heat-shrinkage and then fix them upon cooling like reducer couplings. The functionality of PIHST as reducer coupling can fix subjects that are thousands of times heavier than itself, which is especially useful for some delicate or elaborate equipments since supporting frames can be spared. The reducer coupling effect will facilitate the application of HSTs, as manifested in Figure 2.

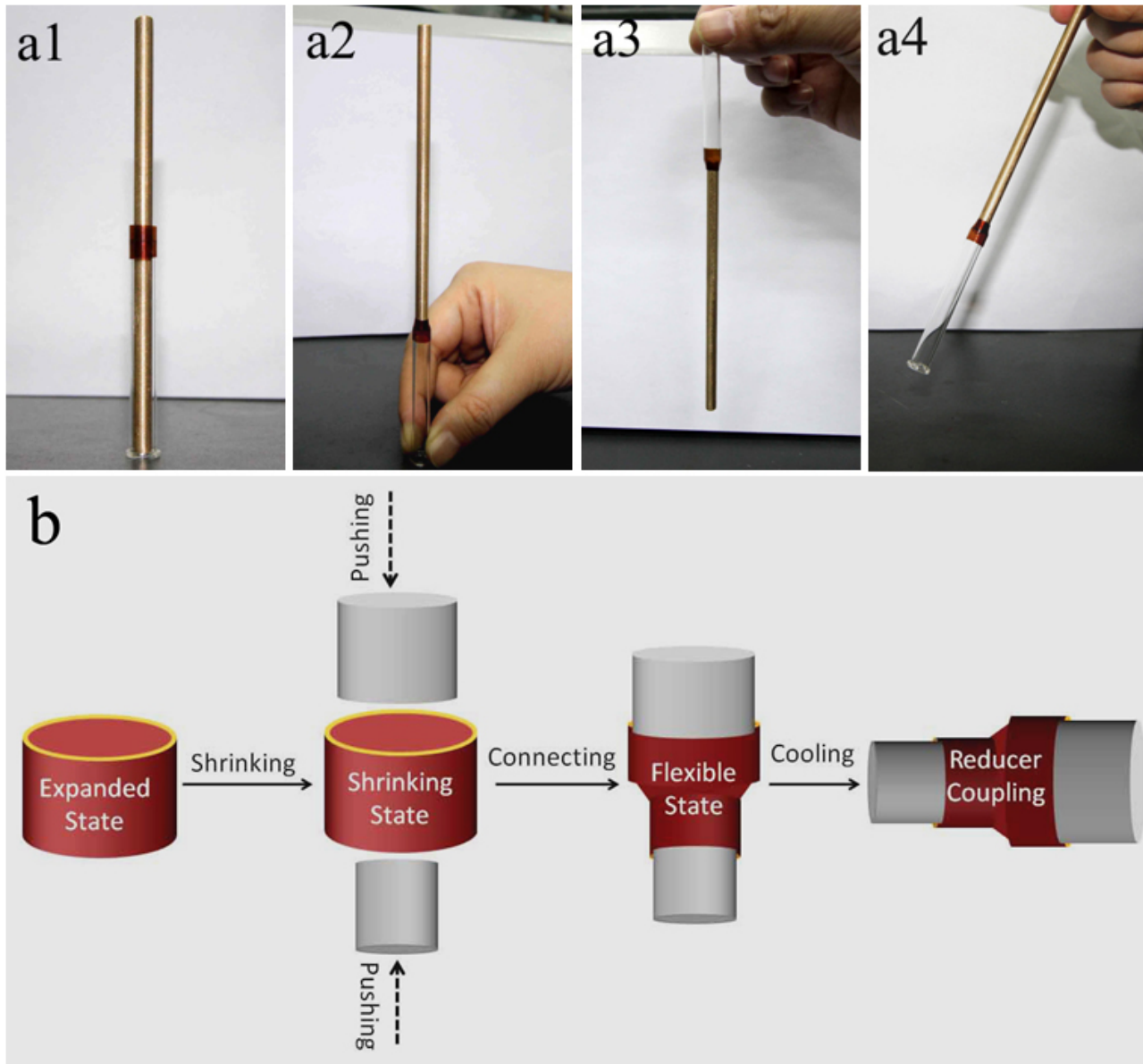


Fig. 2. Practical process (a) and schematic illustration (b) of reducer couplings effect of PIHST. (a1) Expanded PIHST suspended, (a2) reducer coupling effect with copper bar vertically upward, (a3) vertically downward, and (a4) obliquely upward.

With their unique characteristics, the new generation of recyclable and rigid PIHSTs will supply technical solutions to many engineering problems, and in some cases may create a new market.

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[Rigid High Temperature Heat-Shrinkable Polyimide Tubes with Functionality as Reducer Couplings.](#)

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