halide which is an organic substrate to react thereto, (Q^+X^-) as a quaternary ammonium salt being a phase transfer catalyst transfers (CN^-) as a nucleophilic anion to the organic phase where the reaction takes place by exchanging (X^-) as a halogen anion **66** which constitutes its ion pair, for (CN^-) as a nucleophilic anion in the aqueous phase, whereby the reaction is accelerated. After the reaction, the ion pair is formed with (X^-) as the released halogen anion and (Q^+X^-) as a quaternary ammonium salt is formed again and then, returns to the aqueous phase, and thus, such a cycle is repeated.

[**0122**] As the phase transfer catalyst, a phosphonium salt, a cinchoninium salt, a crown ether, cryptand, a dialkyl polyoxyethylene oxide etc. are generally known other than the quaternary ammonium salt.

[**0123**] The efficiency of the reaction in the reaction system using such phase transfer catalyst depends on how the phase transfer catalyst is transferred efficiently to another phase. The efficiency of phase transfer of the phase transfer catalyst is increased as the interfacial surface area between a catalyst phase and a reaction phase is larger and/or the diffusion distance of the phase transfer catalyst is shorter. In a fine space in the fine channel device of the present invention, however, since the interfacial surface area is large and the diffusion distance of molecules is short without a special stirring operation, the phase transfer of the phase transfer catalyst from the catalyst phase to the reaction phase or from the reaction phase to the catalyst phase can effectively be conducted.

[**0124**] In the fine channel in the fine channel device of the present invention, the catalyst phase and the reaction phase flow as laminar flows to keep the fluid boundary therebetween. At the branch portion of the fine channel to branch it into two outlet channels, the reaction phase and the catalyst phase which are in mutual contact are separated. The reaction phase is fed to an outlet channel to take out a product, and the catalyst phase is introduced to the other outlet channel. The catalyst phase discharged from the outlet port is again fed to the inlet port for supplying the catalyst phase. Thus, the phase transfer catalyst in the catalyst phase can easily be separated and recovered for reuse.

[**0125**] The phase transfer catalyst may be an energy dependence phase transfer catalyst. Energy means light or heat. Here, a catalyst causing phase transfer by applying such energy means the energy dependence phase transfer catalyst. When the applicable energy is heat, such energy dependence phase transfer catalyst is called particularly as a temperature dependence phase transfer catalyst.

[**0126**] The concept of the reaction system using the temperature dependence phase transfer catalyst will be described with reference to **FIG. 15**. As shown in **FIG. 15, a** catalyst D **67** in a catalyst phase **68** dissolves in a reaction phase **69** according to temperature rise whereby the reaction between a reaction product A **70** and a reaction product B **71** is accelerated to produce a product C **72**. The solubility of the catalyst D to the reaction phase decreases according to temperature fall whereby the catalyst D returns to the catalyst phase and it does not contribute the reaction. Such catalyst D is generally called as the temperature dependence phase transfer catalyst. As an example of the reaction using such temperature dependence catalyst, Gladysz reaction or Yamamoto reaction as shown in **FIG. 16** are well known.

[**0127**] The efficiency of the reaction system using such temperature dependence phase transfer catalyst depends on how the temperature dependence phase transfer catalyst is transferred efficiently to another phase. Namely, the efficiency of phase transfer of the temperature dependence phase transfer catalyst becomes better as the efficiency of heating/cooling is better or the interfacial surface area between the catalyst phase and the reaction phase is larger, or the diffusion distance of the temperature dependence phase transfer catalyst is shorter. In a fine space in the fine channel device of the present invention, however, since the heat capacity is small and rapid heating or cooling is possible, the phase transfer of the temperature dependence phase transfer catalyst from the catalyst phase to the reaction phase or from the reaction phase to the catalyst phase can effectively be carried out. Further, as described before, since the interfacial surface area is large and the diffusion distance of molecules is short in the fine space without a special stirring operation, the phase transfer of the temperature dependence phase transfer catalyst from the catalyst phase to the reaction phase or from the reaction phase to the catalyst phase can effectively be conducted.

[**0128**] Further, in the fine channel of the fine channel device according to the present invention, the catalyst phase and the reaction phase flow as laminar flows to keep the fluid boundary therebetween. At the branch portion of the fine channel to branch it into two outlet channels, the catalyst phase and the reaction phase which flow as adjacent laminar flows are separated. The reaction phase is introduced into a discharge channel to take out a product, and the catalyst phase is introduced into the other outlet channel. The catalyst phase discharged from the outlet port is again introduced into the inlet port for supplying the catalyst phase whereby the temperature dependency phase transfer catalyst in the catalyst phase can easily be separated and recovered for reuse.

[**0129**] **FIG. 17** shows a reaction system using the temperature dependence phase transfer catalyst in the fine channel device of the present invention. Heaters **73** as heating devices are disposed at an upstream side, e.g., near the inlet ports **11**, of the fine channel **19** to heat the supplied fluid whereby the temperature dependence phase transfer catalyst is transferred efficiently from the catalyst phase to the reaction phase at the upstream side of the fine channel **19** to cause a reaction. A heat insulation material **74** is embedded in the fine channel device **55**, according to a known heat insulation technique, at a downstream side, e.g., near the outlet ports **12**, to isolate heat in the upstream side of the fine channel from the downstream side whereby the temperature of the supplied fluid returned to the room temperature. Thus, the temperature dependence phase transfer catalyst can effectively be transferred to the catalyst phase whereby the catalyst can be separated and recovered for reuse.

[**0130**] **FIG. 18** shows an embodiment of the fine channel device in a case that energy applicable to the energy dependence phase transfer catalyst is light wherein the fine channel device is provided with a light irradiation device for irradiating light to a part of the channel. **FIG. 18** shows the structure of the fine channel device **19** wherein a light spot **77** is formed at a portion of the fine channel **19** by irradiating light **75** through a mask **76**. Other reference numerals in **FIGS. 17 and 18** are the same as those indicated in **FIG. 13**.