it is described that by adding alanine to a cell, strength of the spores of a spore forming microbe is reduced to facilitate the counting of spore forming microbes. According to JP-A No. 2005-253365, a method is described by which microorganisms are admixed with a germination inducing factor and then genes are eluted from them.

Thus, to have a reaction with spore, addition of a germination inducing factor is effective and even for the test based on the ATP method, it is expected that adding germination inducing factor is an effective thing to do.

However, for the ATP method in which various reagents including an ATP eliminating agent, an ATP extracting agent, and a luminescent reagent are added for the reaction, further addition of a germination inducing factor can make the test more cumbersome and can yield a longer test time. Especially, as the reaction with a germination inducing factor takes a relatively a long period of time, the test time becomes longer, making its on-line introduction to a production line difficult.

In addition, when a subject to be tested by the ATP method is an air-borne microorganism, it should be captured in a capturing carrier and then later recovered from the capturing carrier. Time is also required for such process, thus it is problematic in that a long period of time is required from capturing to testing.

SUMMARY OF THE INVENTION

The present ~~invention~~disclosure, which is devised in view of the

above described circumstances, has an object of providing a capturing carrier by which air-borne microorganisms can be captured and tested conveniently and quickly, a capturing device using the capturing carrier, an analysis system using the same and a method for capturing and testing microorganisms. In addition, the present ~~invention~~disclosure provides a capturing carrier of microorganisms and capturing device using the same and an analysis system having the same, and a method for capturing and testing microorganisms, which can solve at least one problem of neglecting a process of taking out microbes from a capturing carrier, poor recovery rate or poor use efficiency, low credibility in microbial counting when microbes are present in an extremely small amount, difficulty in automation and a need for a complicated constitution, low accuracy of measurement as a result of contaminant incorporation and the like, all the problems associated with the application of the ATP method to testing of air-borne microbes.

For the achievement of this purpose, the capturing carrier ~~related to the present invention~~disclosed herein is characterized in that, as a capturing carrier to capture air-borne microorganisms, it comprises a polymer which undergoes a phase transition between gel and sol phase in the temperature range between 15°C and 40°C. In addition to the polymer, it may further comprise alcohols having no bactericidal activity. Further, the polymer is prefereably any one of gelatin or NAGAm/MBPDA.

Next, the capturing carrier ~~of the present invention~~disclosed herein is characterized in that, it is a capturing carrier which can capture

air-borne microorganisms and consists of a polymer which is in a gel phase at the time of capturing microorganisms but undergoes a phase transition under heating to a sol phase at or less than 40°C, i.e., a thermosensitive polymer, and by containing a test reagent in said polymer said test reagent is eluted upon said phase transition from a gel phase to a sol phase. According to this construction, since a polymer which constitutes the capturing carrier is in a gel phase at the time of capturing, air-borne microorganisms can be efficiently captured. In addition, since the phase transition occurs by heating the capturing carrier at or less than 40°C, the microorganisms can be easily suspended in a solated polymer and then recovered without destroying the microorganisms captured in the capturing carrier. Furthermore, as the gel phase polymer contains the test reagent, which is eluted upon phase transition to a sol phase, the test reagent can be added to the microorganisms simultaneously when they are recovered from the capturing carrier.

Therefore, according to the present ~~invention~~disclosure, a process of recovering microorganisms from a capturing carrier and a process of adding a test reagent can be simultaneously carried out. Thus, with the capturing carrier ~~of the present invention~~disclosed herein, by which air-borne microorganisms can be captured and then recovered from the capturing carrier and a test reagent can be added for measurement, processes from capturing to testing of the air-borne microorganisms can be carried out conveniently in short time.

The capturing device for capturing microorganism related to the present ~~invention~~disclosure is characterized in that it comprises,

the capturing carrier comprising a polymer which undergoes a phase transition between a gel and a sol in the temperature range between 15°C and 40°C, and a vessel to contain the capturing carrier.

An analysis system related to the present ~~invention~~disclosure is characterized in that it comprises a holding member which holds the capturing carrier comprising a polymer (hereinafter, may referred to as a thermosensitive resin) which undergoes a phase transition between a gel and a sol in the temperature range between 15°C and 40°C, a temperature controlling apparatus which controls the temperature of the capturing carrier, and an air stream controlling part which introduces air flow to the capturing carrier. The temperature controlling apparatus allows switch between the heating and the cooling of the first member before and after the introduction of air flow to the capturing carrier. Regarding the capturing carrier, the gel phase polymer is placed on the filter for filtering a sol and the capturing carrier comprises a grid plate holding part which holds a grid plate constituting a filtration apparatus in combination with the filter, and the filtration apparatus is designed to filter the polymer that is transformed into a sol by the temperature controlling apparatus.

In one aspect, there is provided an analysis system, which is characterized in that it comprises a holding member which holds a capturing carrier comprising a polymer which undergoes a phase transition between a gel and a sol in the temperature range between 15°C and 40°C, a temperature controlling apparatus which controls the

temperature of the capturing carrier, and an air stream controlling part which introduces air flow to the capturing carrier, wherein an ATP eliminating agent is mixed in the polymer.

Further, it may comprise a device comprising a capturing carrier which consists of a polymer consisting of a thermosensitive resin which undergoes a phase transition between a gel and a sol in a temperature dependent manner, preferably a thermosensitive resin which undergoes a phase transition

between a gel and a sol at 40°C or less, preferably in the temperature range between 15°C and 37°C, and a temperature controlling apparatus, and also preferably a filtration appratus, and if neceesary, a dilution appratus. With a temperature controlling apparatus, the capturing carrier consisting of a polymer (i.e., thermosensitive resin) is maintained in a gel phase to collect air-borne microbes, and then the capturing carrier is subjected to a phase transition to a sol phase by a temperature controlling apparatus or it can be diluted with a dilution solution to yield microbial suspension.

Because the phase transition temperature of the thermosensitive resin material of the present ~~invention~~disclosure is 40°C or less, capturing and recovery of the microbes are carried out under a mild temperature condition. As to the microbial suspension, ATP of the microbes can be measured by applying a conventional ATP method. Alternatively, and preferably, the microbial suspension is filtered to collect the microbes contained in the microbial suspension on a filter, and then ATP measurement is carried out according to a measurement protocol of a modified ATP method, followed by determination of air-borne microbes.

Thus, according to the capturing device or the analysis system ~~related to the present invention~~disclosed herein, at least one effect including easiness of taking out, or recovery, the microbes from the capturing carrier, high recovery rate or high use efficiency, high credibility in microbial counting when microbes are present in an extremely small amount, easiness of establishing an

automation with simple constitution, and high accuracy of measurement even under the influence by contaminant incorporation and the like can be achieved.

The capturing and test method ~~related to the present invention~~disclosed herein is characterized in that it comprises steps of capturing microorganisms by which air-borne microorganisms are captured in a capturing carrier by spraying air comprising air-borne microorganisms to the capturing carrier which consists of a polymer in gel phase and contains a test reagent, and taking out and adding by which the capturing carrier is heated at 40°C or less for a phase transition to a sol phase so that the microorganisms captured in the capturing carrier are recovered from the capturing carrier and at the same time the test reagent is eluted from the capturing carrier, which has undergone a phase transition to a sol phase and then added to the microorganisms above. Thanks to such constitution, recovery of the microorganisms from the capturing carrier and adding a reagent for testing to the microorganisms can be carried out simultaneously. As a result, the operational process becomes easier and less time will be required therefor.

Thus, according to the constitution of the present ~~invention~~disclosure, since the capturing carrier consists of a polymer which undergoes a phase transition from a gel to a sol at 40°C or less and the test reagent is contained in the polymer, by heating the capturing carrier it undergoes a phase transition from a gel to a sol, and the captured microorganisms are taken out of the capturing carrier and at the same time the test reagent