ELECTROPHORESIS GELS

RELATED APPLICATION

The present application is based on U.S. Provisional Patent Application No. 60/073,756 filed Feb. 5, 1998 the entire disclosure and contents of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electrophoresis gels and apparatuses.

2. Description of the Prior Art

In the field of electrophoresis of biomolecules such nucleic acids, peptides and proteins, various kinds of gels have been used as the electrophoresis medium. For example, U.S. Pat. No. 5,143,646 describes the use of polysaccharide gel blends for stacking electrophoresis systems, including gels which are said to be "thermoreversible" and "pH reversible", that is the gels can be liquefied by melting the polymer at high temperatures or changing the pH to neutralize the charge on the gel. It is desirable that the gels used in electrophoresis be reversible so that sections of the gel medium containing each of the different biomolecules can be liquefied and the desired molecules recovered from the liquid solution.

However, in the case of many of the gels described in U.S. Pat. No. 5,143,646, the thermoreversible gels can only be made liquid at relatively high temperatures of 65° C. or greater which that can damage many biomolecules and denature protein molecules. Similarly, the pH reversible gels described in this patent require pH of 3 or less which can also denature or damage protein molecules. Therefore, there exists a need for electrophoresis gel which is reversible at relatively mild conditions which will not damage the biomolecules to be recovered from the liquefied gel.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an electrophoresis apparatus having a gel which is reversible under relatively mild conditions.

It is another object of the present invention to provide a method for recovering biomolecules using such an apparatus.

It is yet another object of the present invention to provide an electrophoresis gel which is reversible under relatively mild conditions.

According to one aspect of the present invention, there is provided an electophoresis apparatus comprising: an electrophoresis medium comprising a gel comprising gellan gum and a cross-linking agent comprising a divalent metal cation; and a means for exposing said electrophoresis medium to an electric field.

According to a second aspect of the present invention there is provided an electophoresis apparatus comprising: an electrophoresis medium comprising a gel comprising gellan gum and a cross-linking agent comprising a diamine; and a means for exposing said electrophoresis medium to an electric field.

According to a third aspect of the present invention there is provided a method for recovering a biomolecules comprising the steps of: adding a mixture containing a biological material to an electrophoresis medium comprising a gel including gellan gum and a divalent metal cation cross-linking agent; exposing said electrophoresis medium to an electric field to separate in said electrophoresis medium said biological material from other compounds in the mixture; removing a zone of the electrophoresis medium containing the biological material from the electrophoresis medium; and recovering the biological material from the removed zone of the electrophoresis medium.

According to a fourth aspect of the present invention there is provided a method for recovering a biomolecule comprising the steps of: adding a mixture containing a biological material to an electrophoresis medium comprising a gel including gellan gum and a diamine cross-linking agent; exposing said electrophoresis medium to an electric field to separate in said electrophoresis medium said biological material from other compounds in said mixture; removing a zone of the electrophoresis medium containing the biological material from the electrophoresis medium; and recovering the biological material from the removed zone of the electrophoresis medium.

According to a fifth aspect of the present invention there is provided a gel comprising gellan gum cross-linked by a diamine.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in conjunction with the accompanying drawings, in which:

FIG. **1** is a graph illustrating the effect of polymer type and molecular weight on the electroosmotic flow in 0.2% gellan electrophoresis gels of the present invention;

FIG. **2** is a graph showing the effect of polyethylene oxide 5,000,000 (PEO 5M) on the separation of supercoiled plasmid (SC) or nicked circular plasmid (NC) in a gellan electrophoresis gel of the present invention;

FIG. **3** is a picture of a gel electrophoresis of DNA using a gellan electrophoresis gel of the present invention cross-linked by Ca^{+2},

FIG. **4** is a picture of a gel electrophoresis of DNA using a gellan electrophoresis gel of the present invention cross-linked by a diamine;

FIG. **5** is a picture of a gel electrophoresis of proteins in a gellan electrophoresis gel of the present invention which contains polyethylene oxide.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Definitions

For the purposes of the present invention, the term "divalent metal cation" refers to divalent group IIA cations such as Ca^{+2}, Mg^{+2}, Sr^{+2}, Ba^{+2}, etc. and to divalent transition metal cations such as Zn^{+2}, Mn^{+2}, Cu^{+2}, etc.

For the purposes of the present invention, the term "diamine" refers to compounds having two or more amine functional groups such as ethylene diamine, hydroxy propane diamine, etc. Although the diamines of the present invention preferably only include two amino groups, in some applications, it may be desirable to use diamines having three or more amino groups. For example, the "diamines" of the present invention include star-shaped dendrites in which there are amino groups at the end of each arm of the star. Typically, the amine groups are separated from each other by a hydrocarbon or hydrocarbon derivative chain.

For the purposes of the present invention, the term "biomolecules" includes nucleic acids, oligonucleotides such as