APPLICATION ACCEPTED AND AMENDMENTS ALLOWED 20.6.90

COMMONWEALTH of AUSTRALIA

PATENTS ACT 1952

600985

APPLICATION FOR A STANDARD PATENT

I/
We ELECTRIC POWER RESEARCH INSTITUTE, INC.,
Of 3412 Hillview Avenue,
Palo Alto, California 94304,
United States of America.

hereby apply for the grant of a Standard Patent for an invention entitled:

"COMOLDED POLYMER COMPOSITES"

which is described in the accompanying ~~provisional~~ complete specification.

Details of basic application(s):—

Number	Convention Country	Date
926,617	UNITED STATES OF AMERICA	3rd November 1986

The address for service is care of DAVIES & COLLISON, Patent Attorneys, of 1 Little Collins Street, Melbourne, in the State of Victoria, Commonwealth of Australia.

Dated this 30th day of October 19 87

To: THE COMMISSIONER OF PATENTS

K. M. Rimington
(a member of the firm of DAVIES & COLLISON for and on behalf of the Applicant).

Davies & Collison, Melbourne and Canberra.

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

DECLARATION IN SUPPORT OF CONVENTION OR NON-CONVENTION APPLICATION FOR A PATENT

In support of the Application made for a patent for an invention

Insert title of invention.

entitled: COMOLDED POLYMER COMPOSITES

Insert full name(s) and address(es) of Declarant(s) being the applicant(s) or person(s) authorized to sign on behalf of an applicant company.

I ~~We~~ HENRY A. DARIUS,

of ELECTRIC POWER RESEARCH INSTITUTE, INC.
3412 Hillview Avenue
Palo Alto, California 94303
United States of America

do solemnly and sincerely declare as follows :–

Cross out whichever of paragraphs 1(a) or 1(b) does not apply.

1(a) relates to application made by individual(s).

1(b) relates to application made by company; insert name of applicant company.

1. (a) ~~I am the applicant~~ ..... for the patent

or (b) I am authorized by

ELECTRIC POWER RESEARCH INSTITUTE, INC.

the applicant..... for the patent to make this declaration on its behalf.

Cross out whichever of paragraphs 2(a) or 2(b) does not apply.

2(a) relates to application made by inventor(s)

2(b) relates to application made by company(s) or person(s) who are not inventor(s); insert full name(s) and address(es) of inventors.

2. (a) ~~I am the actual inventor~~ ..... of the invention

or (b)

SHELDON L. LEVY, a citizen of the United States of America, of 8116 Fontana, Prairie Village, Kansas 66208, United States of America

is ~~are~~ the actual inventor..... of the invention and the facts upon which the applicant..... is ~~are~~ entitled to make the application are as follows :–

State manner in which applicant(s) derive title from inventor(s)

by virtue of assignment of the invention
to the said applicant by the actual inventor.

Cross out paragraphs 3 and 4 for non-convention applications. For convention applications insert basic country(s) followed by date(s) and basic applicant(s).

3. The basic application..... as defined by Section 141 of the Act was ~~were~~ made

in the United States of America on the November 3, 1986

by Sheldon L. Levy

in ..... on the .....

by .....

in ..... on the .....

by .....

4. The basic application..... referred to in paragraph 3 of this Declaration was ~~were~~ the first application..... made in a Convention country in respect of the invention the subject of the application.

Insert place and date of signature.

Declared at Palo Alto, CA this 11th day of September

Signature of Declarant(s) (no attestation required).

By: Henry A. Darius
Its: Secretary and
General Counsel

Note: Initial all alterations.

DAVIES & COLLISON, MELBOURNE and CANBERRA.

(12) PATENT ABRIDGMENT (11) Document No. AU-B-80523/87
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 600985

(54) Title
COMOLDED POLYMER COMPOSITES

International Patent Classification(s)
(51)[4] **B29C 065/44** **B29C 065/70**

(21) Application No. : **80523/87** (22) Application Date : **30.10.87**

(30) Priority Data

(31) Number	(32) Date	(33) Country
926617	03.11.86	US UNITED STATES OF AMERICA

(43) Publication Date : **05.05.88**

(44) Publication Date of Accepted Application : **30.08.90**

(71) Applicant(s)
ELECTRIC POWER RESEARCH INSTITUTE, INC.

(72) Inventor(s)
SHELDON L. LEVY

(74) Attorney or Agent
DAVIES & COLLISON, MELBOURNE

(56) Prior Art Documents
US 4304751

(57) Claim

1. A method for producing a molded composite form comprising a substrate bonded to a thermoplastic element, comprising the steps of:

providing a heated composite of said substrate in contact with said thermoplastic element at a first temperature sufficient to soften said thermoplastic element for a molding operation;

juxtaposing said heated composite in a mold cavity characterised by a predetermined surface configuration, said cavity being at a second temperature less than said first temperature whereby said composite is cooled, and molded into said configuration to form said molded composite, whereby said mold remains substantially isothermal;

and removing said molded composite form from said cavity.

7. The product of any one of the preceding claims substantially as hereinbefore described with reference to the Examples.

600085

COMMONWEALTH OF AUSTRALIA

PATENT ACT 1952

COMPLETE SPECIFICATION

(ORIGINAL)

FOR OFFICE USE

	CLASS	INT. CLASS
Application Number:		
Lodged:		
Complete Specification Lodged:		
Accepted:		
Published:		
Priority:		
Related Art:		

NAME OF APPLICANT: ELECTRIC POWER RESEARCH INSTITUTE, INC.,

ADDRESS OF APPLICANT: 3412 Hillview Avenue,
Palo Alto, California 94304,
United States of America.

NAME(S) OF INVENTOR(S) Sheldon L. LEVY

ADDRESS FOR SERVICE: DAVIES & COLLISON, Patent Attorneys
1 Little Collins Street, Melbourne, 3000.

COMPLETE SPECIFICATION FOR THE INVENTION ENTITLED:

"COMOLDED POLYMER COMPOSITES"

The following statement is a full description of this invention, including the best method of performing it known to us :-

COMOLDED POLYMER COMPOSITES

The present invention is directed to a method for producing composite materials formed by comolding of a polymer layer onto a substrate. In particular, the present invention is directed to a process for the manufacture of composite glass-plastic articles.

Composite materials wherein one of the materials is a plastic and the other material is a hard substrate are important for many applications. Such composites take advantage, for example, of the properties of the plastic material which is light, thermally formable at relatively low temperatures and which may have desirable optical properties. The properties of the substrate, which in many instances is glass, are also useful in that it can be durable, scratch-resistant and chemically relatively inert. For example, the advantages of combining the light weight of clear plastics with the scratch-resistance and chemical durability of glass in a composite material usable as a lens is disclosed in Patent No. 2,361,589. Heretofore, approaches to forming lenses, either by molding or casting, have been to contact the plastic (polymer) material with the substrate (usually glass) sometimes with an interstitial bonding adhesive, and to place the composite into a cold mold, and then to heat the entire assembly, including the mold, to a

temperature at which the plastic, which may be thermosetting, and/or the adhesive, which may be thermoplastic, is molded and bonded to the substrate. Depending on the plastic and the adhesive, if used, a subsequent heat curing is sometimes utilized. Examples of such processes are disclosed in Patent Nos. 4,227,950 and 3,982,822.

Disadvantages of these methods, however, are that the processes are inefficient because the time and heat energy required to thermally cycle the mold is wasteful, i.e., the mold must be cooled before it can be reused. Furthermore, by heating the mold while it is in contact with the surfaces to be molded, the likelihood of adhesion of the polymer surface to the surface of the mold increases, sometimes requiring an additional step to release the molded article from the mold.

Injection molding is used, but sometimes this method cannot be utilized if extremely thin polymer layers are required.

It is, therefore, an object of the present invention to provide an improved method for producing composite materials by comolding of a polymer layer onto a substrate, which is efficient both in the time required to form the molded product and in the energy required to recycle the mold.

It is a further object of the present invention to provide an improved method for manufacturing lenses comprising a polymer and a glass substrate.

The present invention provides a method for producing a molded composite form comprising a substrate bonded to a thermoplastic element, comprising the steps of:

providing a heated composite of said substrate in contact with said thermoplastic element at a first temperature sufficient to soften said thermoplastic element for a molding operation;

juxtaposing said heated composite in a mold cavity characterised by a predetermined surface configuration, said cavity being at a second temperature less than said first temperature whereby said composite is cooled, and molded into said configuration to form said molded composite, whereby said mold remains substantially isothermal;

and removing said molded composite form from said cavity.

A comolded composite article is produced comprising a substrate bonded to a thermoplastic element by a method which includes the step of heating the unmolded composite prior to placement into a cold mold cavity. A surface-active agent may also be used to prime the surface of the thermoplastic or substrate surface. Suitable primers include silanating agents.

The method of the invention comprises the initial step of providing a heated composite of the substrate in contact with the thermoplastic element at a first

temperature sufficient to soften the thermoplastic element to a formable state for a molding operation. Many thermoplastics are known in the art and the range permissible for the first temperature will depend upon the particular thermoplastic which is utilized. Commonly used thermoplastic elements for making lenses includes such polymers as methyl methacrylate polymers, cellulose acetate butyrate polymers, carbonates, such as epoxy and allyl carbonates. Preferably the thermoplastic will be cross-linked so that at the temperature at which it is intended to be used it will have rigidity. Other thermoplastic elements include ionomers because of their usual low creep rate below their melting point and high rigidity.

The thermoplastic element may also be thermosetting, although it is not critical to the present invention. If the thermoplastic element is also thermosetting, the time between the preheating step and the step of placement of the composite into the cold mold will be carefully regulated to insure that thermosetting does not occur prior to the formation of the predetermined surface configuration in the mold. The temperature at which the composite is heated will depend upon the particular thermoplastic element which is utilized. Preferably, this temperature is within the range of about 70-180°C.

The substrate and the thermoplastic element may be first contacted and then heated together in one embodiment of the invention. Alternatively, the substrate may be separately heated, contacted with the cool thermoplastic element, then the warm composite will be placed in the mold. Combinations of these methods may also be utilized whereby the

substrate and thermoplastic element are heated separately then contacted with each other prior to placement into the mold. The method which is chosen will in part depend upon the type of thermoplastic element which is utilized, as well as the first temperature which is required to obtain bond strength and durability.

According to the present invention, after the heated composite is placed into a cool mold cavity (usually at above room temperature, i.e., at about 40-50°C), the mold is clamped, whereby the thermoplastic element and substrate are comolded into the desired shape. The comolded composite cools during the molding process by transfer of heat to the mold, but due to the mass and heat capacity, the mold itself remains essentially isothermal throughout the molding process.

The exact amount of time and the temperature to which the substrate and the thermoplastic element are heated, separately or together, prior to insertion into the mold may be readily determined by those of ordinary skill in the art. It will be dependent upon, at least in part, the type of thermoplastic element which is used, the relative thickness of the desired molded product to be formed, mold pressure, and the like. These temperatures and times may be determined by those skilled in the art and/or from the specification provided by the manufacturing source of the particular thermoplastic element.

Conventional molding apparatus having steel platens may be utilized to conduct the process according to the present invention.

The method according to the present invention is particularly useful for the production of optical elements, and in particular Fresnel lenses.

The invention may be further understood by reference to the following examples illustrating some preferred procedures for the production of molded composite products in accordance with the present invention.

EXAMPLE

An 18 mil thick sheet of SURLYN®, an ionomer made by DuPont, at 20°C is placed on a 0.125 inch thick glass plate that has been preheated to 160°C (320°F). The sheet quickly heats up to about 140°C (280°F). The composite is then placed into a mold having a steel platen and electroformed - nickel form on the SURLYN® side (initially at 50°C (122°F)) and steel platen (initially at 40°C (104°F)) on the glass side. The outer sides of the platens are kept at the initial temperature by steam at saturation pressure. The assembly is clamped, remaining in that position for about 15 seconds. Upon opening the mold assembly the formed lens is freely released from the mold and the lens is of optical quality, free of glass and plastic defects.

The foregoing example is illustrative of the procedures by which the composite article may be provided in accordance with the present invention. Various other processing techniques may be resorted to fabricating lenses, as well as other composite articles within the scope of the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for producing a molded composite form comprising a substrate bonded to a thermoplastic element, comprising the steps of:

providing a heated composite of said substrate in contact with said thermoplastic element at a first temperature sufficient to soften said thermoplastic element for a molding operation;

juxtaposing said heated composite in a mold cavity characterised by a predetermined surface configuration, said cavity being at a second temperature less than said first temperature whereby said composite is cooled, and molded into said configuration to form said molded composite, whereby said mold remains substantially isothermal;

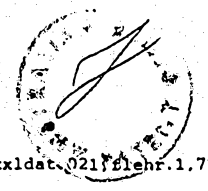
and removing said molded composite form from said cavity.

2. The method according to claim 1 wherein said step of providing said heated composite comprises the steps of separately heating said substrate and then contacting said heated substrate with said thermoplastic element.

3. The method according to claim 1 wherein said molded composite form is an optical element.

4. The method according to claim 1 wherein said first temperature is in the range of 70-180°C.

5. The method according to claim 4 wherein said second temperature is in the range of 40-50°C.



6. A method of producing a molded composite form substantially as hereinbefore described with reference to the Examples.

7. The product of any one of the preceding claims substantially as hereinbefore described with reference to the Examples.

DATED this 7th day of June, 1990.

ELECTRIC POWER RESEARCH INSTITUTE, INC.
By its Patent Attorneys
DAVIES & COLLISON